Established 1916 as THE OIL WEEKLY

JANUARY, 1956

# WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING PRODUCING OPERATIONS AND MANAGEMENT

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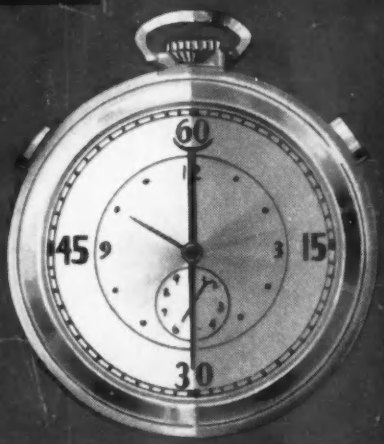

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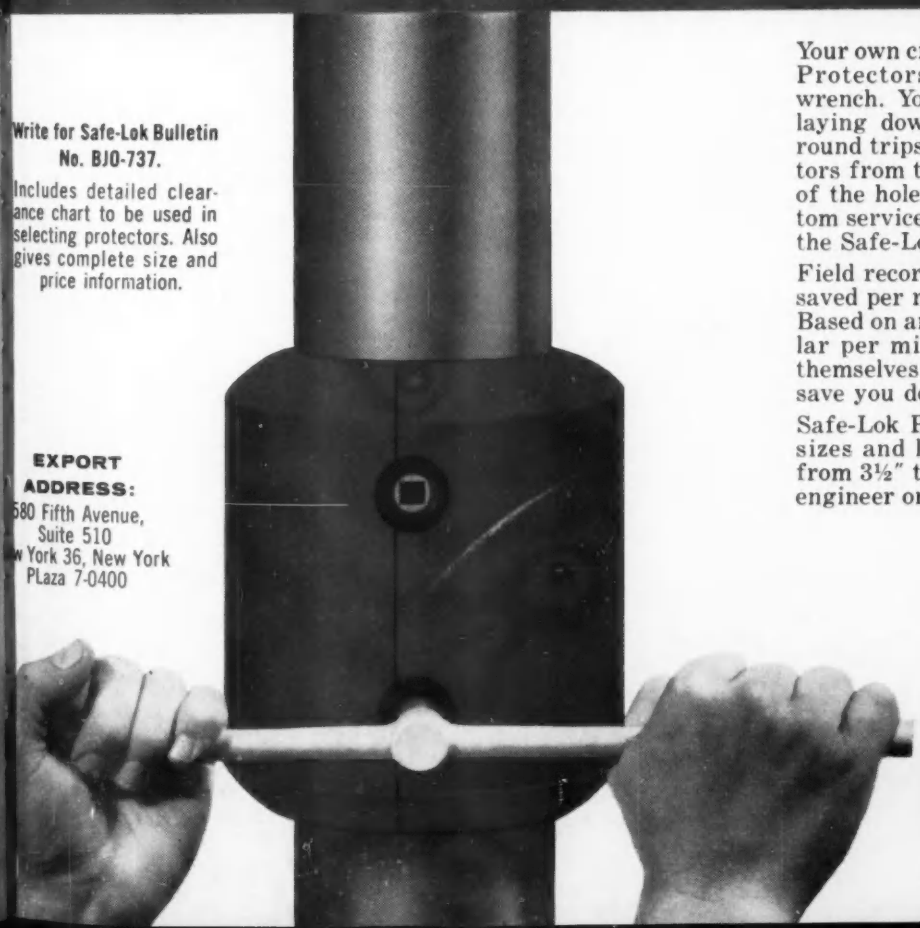

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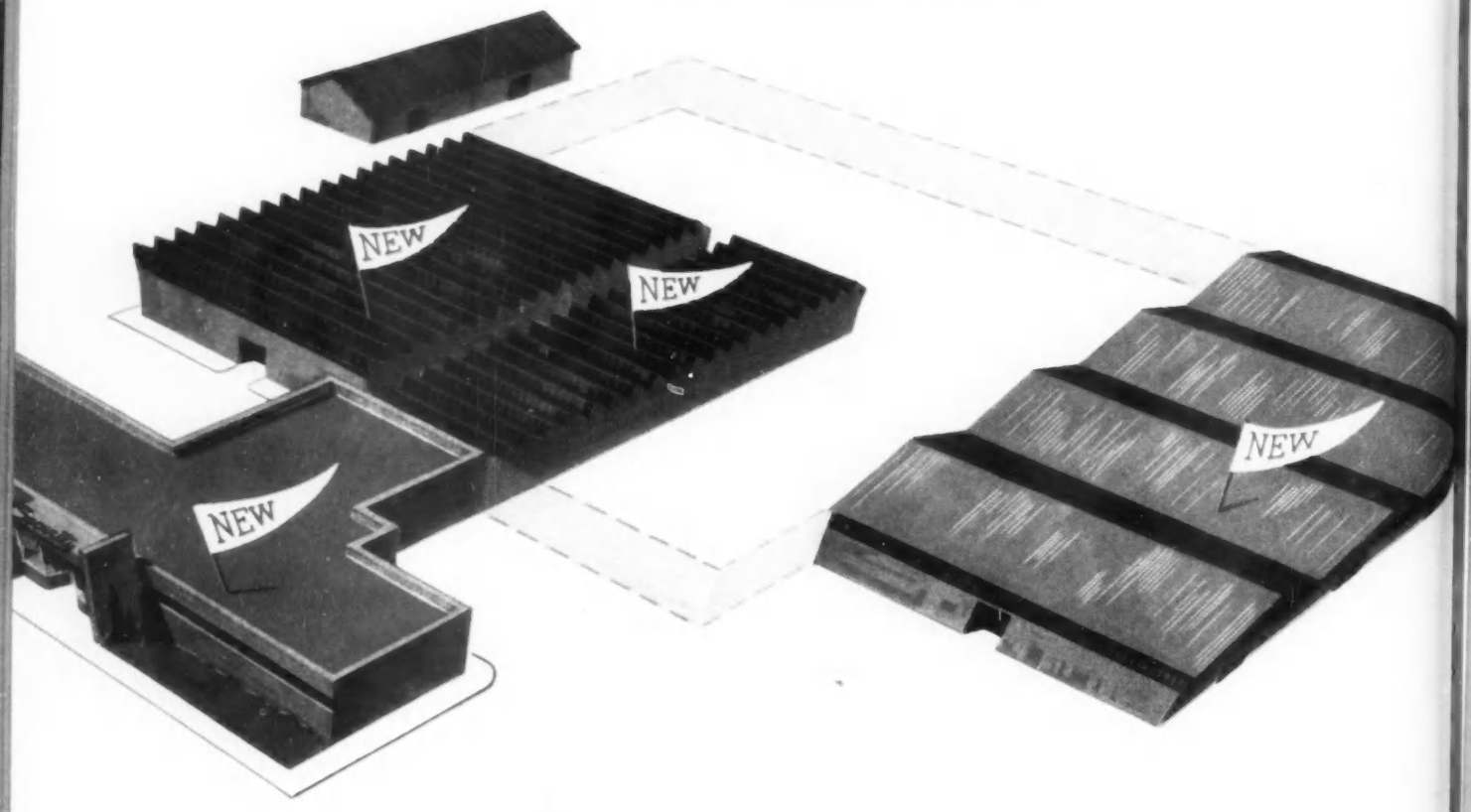

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January, 1956

# WORLD OIL

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# a quick look at WORLD OIL THIS MONTH

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

### CURRENT OUTLOOK

☐ **In searching** for commercial uranium ore deposits, test holes can be drilled economically to depths of 50 or 100 feet with the jack-hammer type drill. But for tests from 100 feet down to 1000 feet, the most economical means of drilling is with the heavy type seismic shot-hole drill, equipped with large air compressor. The hole is drilled to desired depth, with air removing drill cuttings, and a recording device is lowered in the hole to detect possible radioactive material; dust samples are taken at 5 or 10-foot intervals. If a promising pay section is encountered, a core is cut with a diamond core head, and the core assayed. If this core and cores from adjacent tests indicate commercial ore, the stage is set for mining operations. For details

Turn the Page ➧

## *How to Get Your Copy of the 1955 WORLD OIL Editorial Index . . .*

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on drilling for uranium, see **Page 44. Finding Uranium with a Drilling Rig**.....**Dr. Sidon Harris**

☐ **The independent operator** and individual investor are doing well in Illinois and Kentucky where their dollars are accomplishing more today than ever before. Shallow depths, good price, no proration and quick pay-outs make the area one of the most attractive in the country. Turn to **Page 48. Rim Areas Paying Off in Illinois and Kentucky**.....**E. E. Rehn**

☐ **Too many companies,** particularly small ones, hire too many job misfits. These mistakes are costly to the firm and to the individual being hired. For a time-tested way to improve your personnel selection methods, see **Page 52. Hiring Is a Science.**
**Harold A. Edgerton**

☐ **A glamorous new title** has been given to a concept as old as civilization. That new title is "automation." What effect will this new word have on labor and management? For the answer to this timely question, turn to **Page 56. Automation—the Glamor Word of Industry** .....**M. L. Powers**

☐ **Far too much gasoline** may be added to stocks during the remaining winter months unless industry reduces crude runs to U. S. refineries and adjusts refinery yields to produce more distillate fuel oil and less gasoline. Serious trouble next spring is a possibility. Read **Page 70. Report From the Observatory.**
**Ray L. Dudley and Warren L. Baker**

☐ **Whose job is it?** There has been a lot of talk about the oil industry not getting a fair shake at the altar of public opinion. Assuming this is so, whose job is it to present the real picture? Turn to **Page 43** for a few brief words that wipe away any mystery of how to do it . . . a few brief words that drop the mantle of public relations man on the millions in the oil industry. **Publisher's Page**.....**Ray L. Dudley**

☐ **Another good year** is in prospect for the oil industry in 1956. Some further improvement over the exceptionally favorable operating results of 1955 are anticipated. Oil demand is due to increase 4 to 5 percent. That rise will justify corresponding increases in operations. For details about the 1956 outlook, read **Changing Panorama** .....**Page 62**

### EXPLORATION ARTICLES

☐ **Here is a description** of the Genou Trend of north central Montana—a pre-Cambrian basement ridge on which there are a number of higher areas. Turn to **Page 79. Take a Look at Montana's Genou Trend.**
**Andrew G. Alpha**

☐ **Geologic study indicates** additional accumulations of oil may exist in north central Oklahoma. Turn to **Page 86** for a wrap-up of existing conditions in this area. **North Central Oklahoma Offers Good Possibilities** .....**Roger R. Patton**

☐ **What About Nevada?** Nevada's production is restricted to the Railroad valley area. But continued exploratory efforts may uncover other productive areas. **Exploration Continues in Nevada**.....**Page 96**

### DRILLING ARTICLES

☐ **The first cement** to be developed exclusively for oil well usage is now available. It is a complex aluminous cement that will not readily contaminate with drilling mud. It provides a good bond and has a low water loss. For more information on this new development, turn to **Page 99. New Aluminous Cement Developed for Oil Wells**....**J. S. Talbot and Anthony Gibbon**

☐ **A new hydraulic drill collar** has helped dampen vibrations due to rough drilling action. These vibrations can prove harmful to bits, drill stems and surface rig equipment. In some cases, this new drill collar has been credited with increasing penetration rates. For more details, read the article beginning on **Page 101. Hydraulic Drill Collars Increase Drilling Efficiency. Alain Seligman**

☐ **A possible new depth record using natural gas** as a circulating medium was established by El Paso Natural Gas Company upon abandonment of a well in the Delaware Basin. Gas drilling from 8077 feet to 13,732 feet resulted in a 66 percent decrease in costs, control of lost circulation, and faster penetration rates. These results point up the savings of natural gas drilling at these depths. Turn to **Page 109. Drilling in the Delaware Basin Shows New Depths Reached With Natural Gas** .....**W. W. Dallas and E. J. Coel, Jr.**

☐ **The all important question**—How much?—is answered in this third and concluding installment on air drilling. Initial costs and returns are discussed. Turn to **Page 112** and read about the economic considerations of air drilling. **When Does It Pay to Drill With Air?** .....**James T. Morris and Robert P. Ramsey**

**WORLD OIL, published every month except semi-monthly in February and August. Entered as THE OIL WEEKLY as second class mail matter December 23, 1916, at postoffice at Houston, Texas, under the act of March 3, 1879.**

# Looking Ahead . . .

. . . **Petroleum demand in the Free World** is expected to increase about 5.8 percent in 1956, following the 8.5 percent rise of 1955. The demand in free countries outside the U. S. probably will rise about 8.5 percent in 1956. It mushroomed about 11 percent in 1955. Europe and Latin America are showing extra sharp gains. U. S. consumption probably will increase about 4.2 percent in 1956. That would be a normal growth. The domestic use rose about 7.1 percent in 1955. But that gain was exceptional. It compensated for a subnormal increase of only about 2 percent in 1954. (See the analysis of the oil industry outlook for 1956 on Page 62.)

•

. . . **Crude prices in the U. S.** will continue unchanged during 1956, according to some forecasts. If so, currently higher costs of materials and wages will have to be absorbed by producers. Earnings of producers will be bolstered, however, by a moderate increase in domestic crude output. Greater demand for petroleum products will require more crude. Executives of Standard Oil companies of Indiana and New Jersey recently predicted no change in crude postings in the near future.

•

. . . **Tending to hold down prices of crude and products** are the ample supplies both abroad and in the U. S. World reserves and producing ability are greater than ever before. World refining capacity also is at a record high level. Foreign supplies are assuming increased importance in determining price levels in world markets for petroleum. Even in the U. S. there is at present a very substantial excess of crude producing ability over market requirements. There is also a large excess of refining capacity. If product prices increased, there would be strong temptation to run too much crude to refinery stills. Resultant surpluses of products in storage would jeopardize prices of all oils.

•

. . . **Prices of oils in the U. S.** currently are being influenced not only by conditions within the world oil industry but also by general economic conditions surrounding the industry. Exerting upward pressure on prices are past and prospective increases in wages and costs of many materials. Tending to hold prices down, on the other hand, are tighter credit, lower farm prices and reduced farm income, and prospective declines in activity in some lines, including residential construction and automobile production.

•

. . . **Oil consumption will be materially expanded** in the future by new uses not yet discovered or developed. The new products will be developed through research. Petrochemicals developed within a comparatively few recent years have made a significant market outlet for oil and gas. Jet fuel was practically unknown ten years ago. It is now produced in volume greater than that of lubricants and more than half that of kerosine. Possibly a great variety of new products may be developed eventually through application of atomic science to refining processes. Research toward that end is under way.

•

. . . **Significant to the oil industry** is the prospective further large expansion of aviation and the market for aviation fuels. The air lines, as well as the Air Force, have been placing heavy orders for new planes. Steady increases in civilian air travel are forecast. The aircraft manufacturers will be kept very busy for years ahead. Consumption of jet fuel has been increasing sharply and doubtless will continue to grow vigorously.

•

. . . **Costs of atomic power stations will be cut** 30 to 40 percent in the next five years. Atomic energy thereby will be made widely competitive with other energy sources. No efficient existing power plant will be shut down or converted to atomic power in the next 25 years. But 65 percent of new power plants in the U. S. 25 years from now will be atomic. At that time, conventional fuels cannot carry the whole energy load. They will need to be supplemented by atomic power. These predictions summarize recent forecasts of several business executives well informed on atomic energy.

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# Whose Job Is It?

**Whose job is it** to see that the oil business has a better understanding at the hands of the public? Is it just the job of the American Petroleum Institute and its committees? Is it just the job of the company executive who may be a heavy stockholder—or who may not be but who has an interest in keeping a good job?

No, the responsibility goes far deeper than that. It goes to *every* individual who works in the oil business whether he works out in the oil fields, in a refinery, on a pipe line or works at a pump in a filling station.

If he intends to stay in the oil business then he had better do everything he can to help the oil industry get and maintain a good name at the hands of the public. His job is likely to be just about as stable as is the reputation of his industry.

How can you or anyone employed in the oil industry help it to secure and maintain a good name?

The answer to that is easy:

- So conduct yourself in all of your operations as an oil man in contact with the public so that the public will feel "that's a good oil company to do business with."
- If you hear somebody making a statement about the oil industry which your own information tells you is untrue, correct it in a friendly manner.

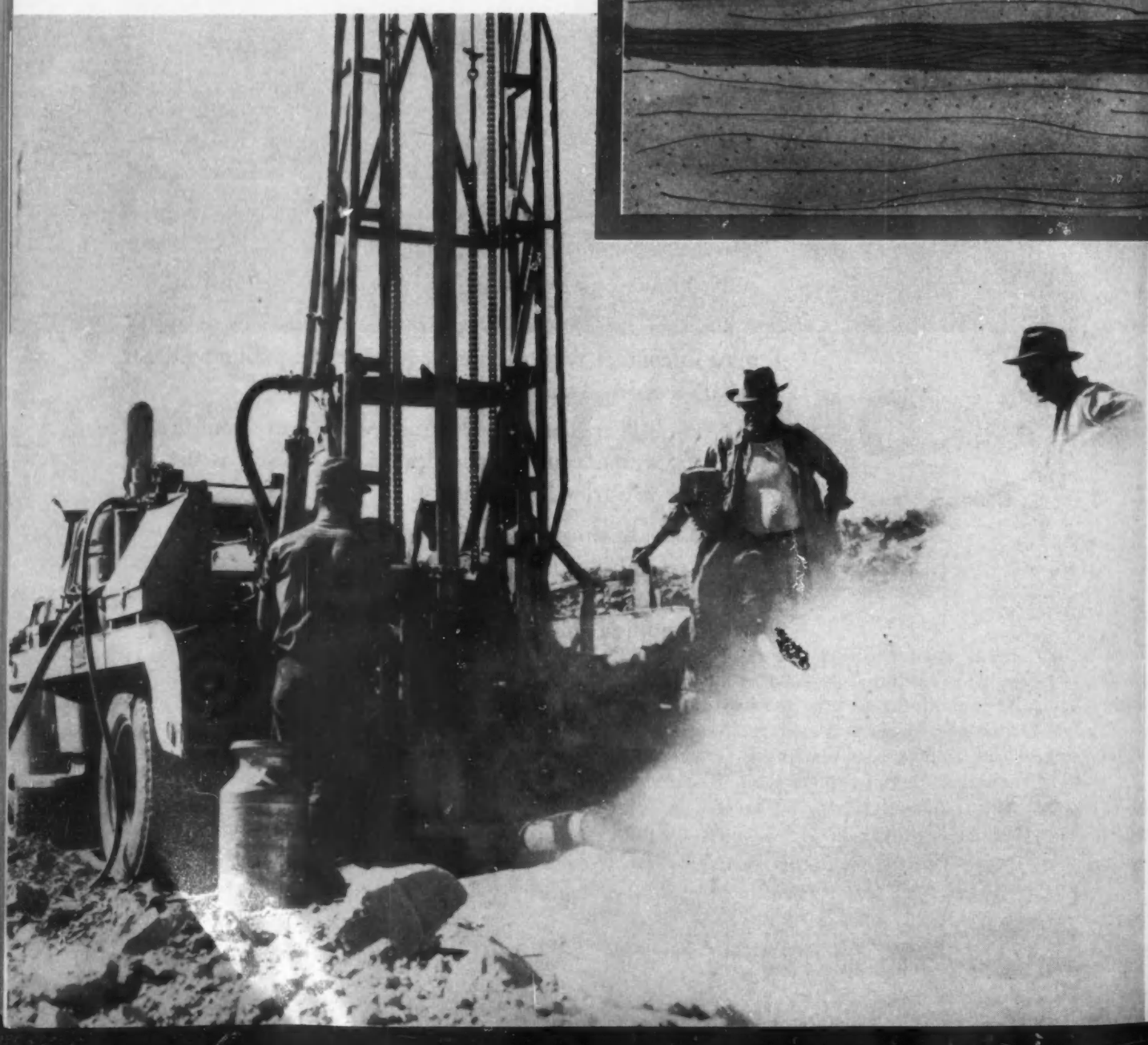
It is just as simple as that. If the several million employes of the oil industry in the U. S. will do just these two things, the results will be far greater than could be expected from a multi-million dollar advertising campaign.

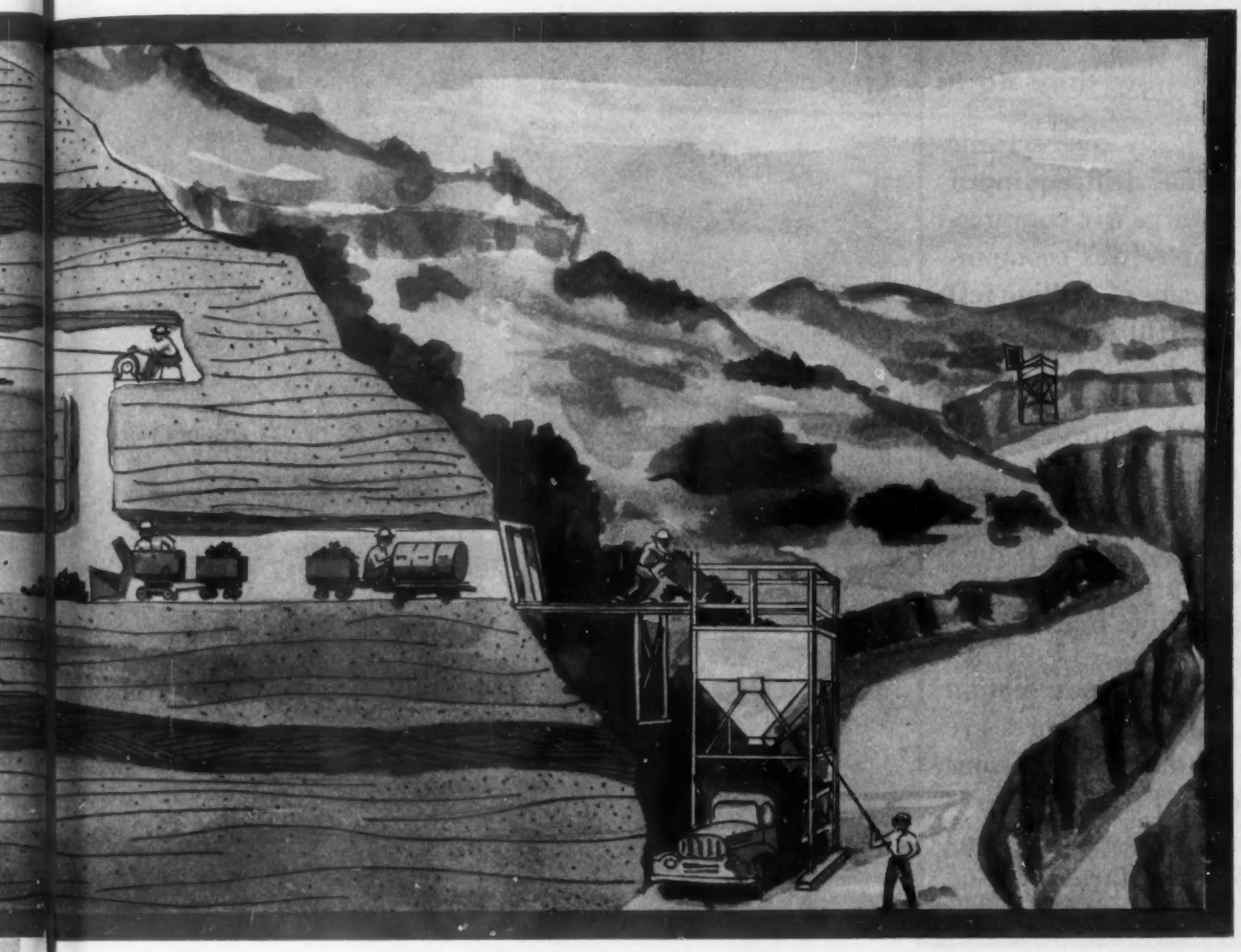
And just as an editorial writer in one of our publications said last month, "this is not a job for just a week in the year —it is an every-day job, 365 (leap year 366) days in the year."

Ray L. Dudley

# FINDING URANIUM...

Close-up view of drilling rig seeking uranium. Drill cuttings are removed by air from an air compressor; being blown out here as dust. Dust samples are taken at 5 or 10-foot intervals.





**Mining uranium in the Four Corners area. Techniques developed by the oil industry are now being applied successfully in locating buried ore bodies. The use of seismic drilling equipment is coming to the fore and it is estimated that as many as 200 "heavy type" seismic shot-hole rotary drills are being used in exploring for uranium in the Rocky Mountain area.**

Reproduced from "Atoms and Investors," a pamphlet published by Merrill Lynch, Pierce, Fenner & Beane.

# WITH A DRILLING RIG

**By DR. SIDON HARRIS,** President,
Southern Geophysical Company, Fort Worth

FOR THE PAST three years considerable increase in activity has occured in the search for commercial uranium ores by both professional and amateur prospectors. The majority of this exploration has been confined to what is generally defined as the "Four Corners Area," roughly defined as southwestern Colorado, southeastern Utah, northeastern Arizona and northwestern New Mexico. Some commercial ore deposits also have been detected in Wyoming, California and Texas.

Increased interest in uranium exploration began in 1952 and was caused principally by federal stabilization of prices for uranium ore, and stimulation furnished through aid and additional incentive programs funnelled through the Atomic Energy Commission.

Public interest has been further accentuated by the highly publicized "strike" of Charles Steen in southeastern Utah. Prior to 1952 of course, the AEC and major mining concerns were quietly pursuing active exploration for commercial deposits of uranium ores. Up to 1952, most of the core drilling was done with "jackhammer" drills, which are quite effective to a depth of 50 feet or so, and with diamond bit, high speed, small rotary drills employing water for return of samples and cleaning the hole.

When this exploration campaign received a great impetus during 1952, especially in the "Four Corners Area," the probers for commercial ore immediately began reaching for greater depths as well as seeing a substantial increase in their number. Likewise, the exploration campaign began

**Here's how they do it:**

- **Heavy type seismic shot-hole drill, equipped with large air compressor, provides economical means of drilling test holes 100 to 1,000 feet deep.**
- **Air removes drill cuttings, and dust samples are obtained; and recording device is lowered in hole to detect radioactive material.**
- **If good pay section is indicated, cores are cut and assayed. If commercial deposit is revealed, mining operations are started.**

After the test hole is drilled to the desired depth, a recording instrument is lowered into the hole, as shown here. If a promising pay section is indicated, a core is cut with a diamond core head, and the core is assayed. If such tests indicate commercial uranium ore, mining operations are started.

Scenic shot showing rugged terrain typical of the Four Corners area, where much of the

sweeping much larger areas, involving the drilling of test holes in sections where the use of water for the return of cuttings was extremely impractical, as a result of steep bulldozed trails and long distances to sources of water.

Hence, during 1952, the use of "heavy type" seismic shot-hole rotary drills in the uranium exploration program began to make its appearance. It is extremely difficult to estimate the number of such rotary-type drilling rigs, employing air compressors for the return of cuttings and cleaning the hole, that are now in operation in exploring for uranium in the Rocky Mountain area. However, a fair guess would be around 200 such units.

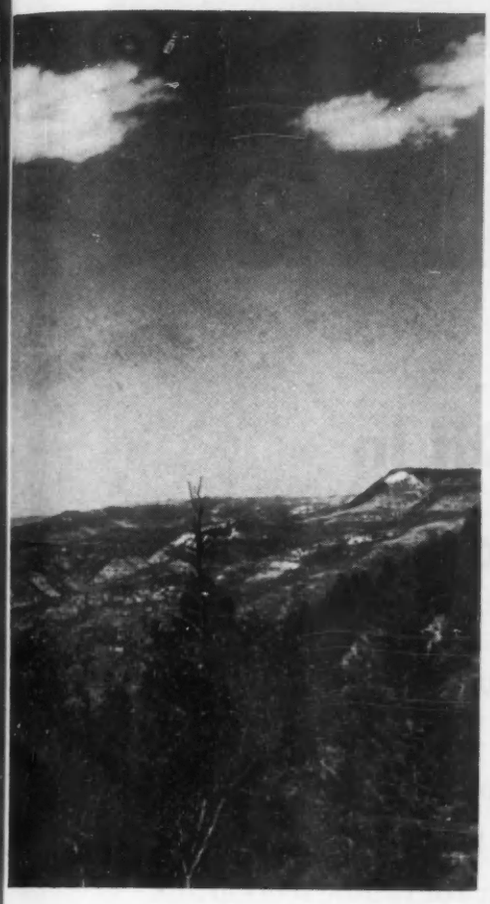
When it is considered that an average "claim" consists of approximately twenty acres, and that a minimum exploratory drilling program would require at least ten test holes per claim, it can readily be seen that adequate and economically sound drilling equipment is an essential part in the general exploration picture for uranium ores.

Under usual procedure, prospectors, mining companies, oil operators, and others stake out claims in any area which they feel, from preliminary investigations, might prove economically productive at depths not below 1000 feet. These preliminary investigations usually include information furnished free by the AEC and gathered from surveys, some of which are air borne, which include geological investigations of surface conditions.

However, to date, except for certain rare deposits which are so close to the surface that the ore can be scooped up with steam shovels, it has been necessary to drill test holes as mentioned above to anticipated geological formations such as the Chinle, Shinarump and the Morrison formations to determine whether or not a commercial ore body is present. Even after commercial ore has been detected, considerable additional testing is necessary to determine the limits of the ore body and its possible dollar value in the ground before cutting a shaft and initiating actual mining operations.

Generally speaking, these ore bodies are rather small and it is possible that a number of smaller commercial ore bodies may be encountered in a relatively small number of claims. For example, in one instance a $3 million ore body was outlined which covered only 10,000 square feet; i.e., a square approximately 100 x 100 feet dimensions. It can therefore be seen that test holes must be closely spaced in order to be sure that a substantial ore body is not overlooked.

After a set of claims bearing from 10 to perhaps as high as 100 or more have been staked out by an operator based on some preliminary reconnaissance (geologically or radio active surveys or both), a drilling program is then necessary to determine the possible value of the claims. Naturally, drilling is begun in what is believed to be the best possible location. The test holes are spaced not over 100



exploration for uranium in the U. S. has been concentrated.

Drilling rig in use in search for uranium. The operation is in a typical area of the Four Corners region. The rugged terrain and unavailability of water make it most practical to use air instead of water or drilling fluid in drilling the test hole. The air compressor is mounted on truck at extreme left.

## About the Author

DR. SIDON HARRIS, president of Southern Geophysical Company, Fort Worth, has published numerous articles in scientific and trade journals in the U. S. and abroad. He entered the geophysical profession in 1929, going with Humble Oil & Refining Company, after getting B.A. and M.A. degrees in physics at The University of Texas. Through graduate work at Rice Institute and The University of Texas, Harris received a Ph.D. in physics in 1934. Before organizing Southern Geophysical Company in 1944, he was on the faculty of Oklahoma A. & M. College and later worked for Western Geophysical Company and the Geophysical department of Stanolind Oil & Gas Co.

feet apart in a line across the claims in one direction and with lines spaced not more than 300 to 500 feet apart. Cases have been known where one operator became discouraged after spending $20,000 to $30,000 or even more in testing a set of claims and abandoned them, and then another operator took the claims and drilled test holes between the barren ones and discovered commercial ore.

Most of the test holes currently being drilled in the "Four Corners Area" are less than 500 feet in depth; however, some do go to as much as 1000 feet. For holes from 50 to 100 feet in depth, the jack-hammer type drill is perhaps the most economical.

From 100 feet on down to 1000 feet the heavy type seismic shot-hole drill equipped with a large air compressor appears to be the most economical means of making these tests. Cost per foot for drilling varies considerably over the area, depending upon depth, hardness of over-lying strata, and the relative difficulty in moving the equipment. Frequently the expense for bulldozing trails over a set of claims is a major portion of the total expense of testing.

The cost per foot varies from as low as something around 50 cents to as high as $4 or $5.

The most economical means of testing a set of claims from 100 feet to 500 feet or more is the use of the heavy seismic shot-hole drill with air compressor. This method consists of drilling to the desired depths with air removing the drill cutting and then lowering a recording device in the hole to detect any possible radioactive material thick enough to be of commercial value. This information is correlated with dust samples taken at intervals of five to ten feet as the hole is being drilled with air.

When a "hot" hole is discovered, the usual procedure is to immediately pull in with tighter control and begin roughly outlining the potential ore body. After a few good radiometric logs have been obtained to establish a potential uranium ore body, a hole is cut to the top of the "pay section" and then a core is cut with a diamond core head either with air or water. This core is then assayed to obtain the exact percentage of commercial ore. Drilling is resumed with tight control, holes being spaced 15 to 20 feet apart to further outline the limits of the ore body and if it then appears that the extent of the ore deposit is of probable commercial value, a few more sample cores are cut and assayed to determine the dollar value of the particular deposits. At this point, exploration ceases and actual mining operations begin.

Undoubtedly, although some of the public hysteria with reference to uranium has subsided, vast amounts of continued exploration for commercial deposits of uranium ore will continue throughout the Rocky Mountain area, in California, Texas, and perhaps other sections within the Continental U.S. And undoubtedly, the heavy type shot-hole drill with innovations and adaptations will continue to play a prominent role in the program.

—The End

Flares in the Eldorado field of Illinois.

# Rim Areas Paying Off In Illinois and Kentucky

**• Exploration and development successful in shallow sand areas along southern and western rims of Eastern Interior Basin.**

**• Relatively fast pay-out of wells made possible by reasonable lease costs, fair taxes, shallow depths, and absence of proration.**

**• Development is facilitated by simple stratigraphic section and availability of extensive geological information.**

**By E. E. REHN,**
Petroleum Geologist.
Evansville, Indiana

SUCCESS is rewarding exploration and development in the shallow sand areas of southernmost Illinois and western Kentucky, along the southern and western rims of the Eastern Interior basin. The areas represent a profitable hunting ground for the oil producer, particlularly the independent operator.

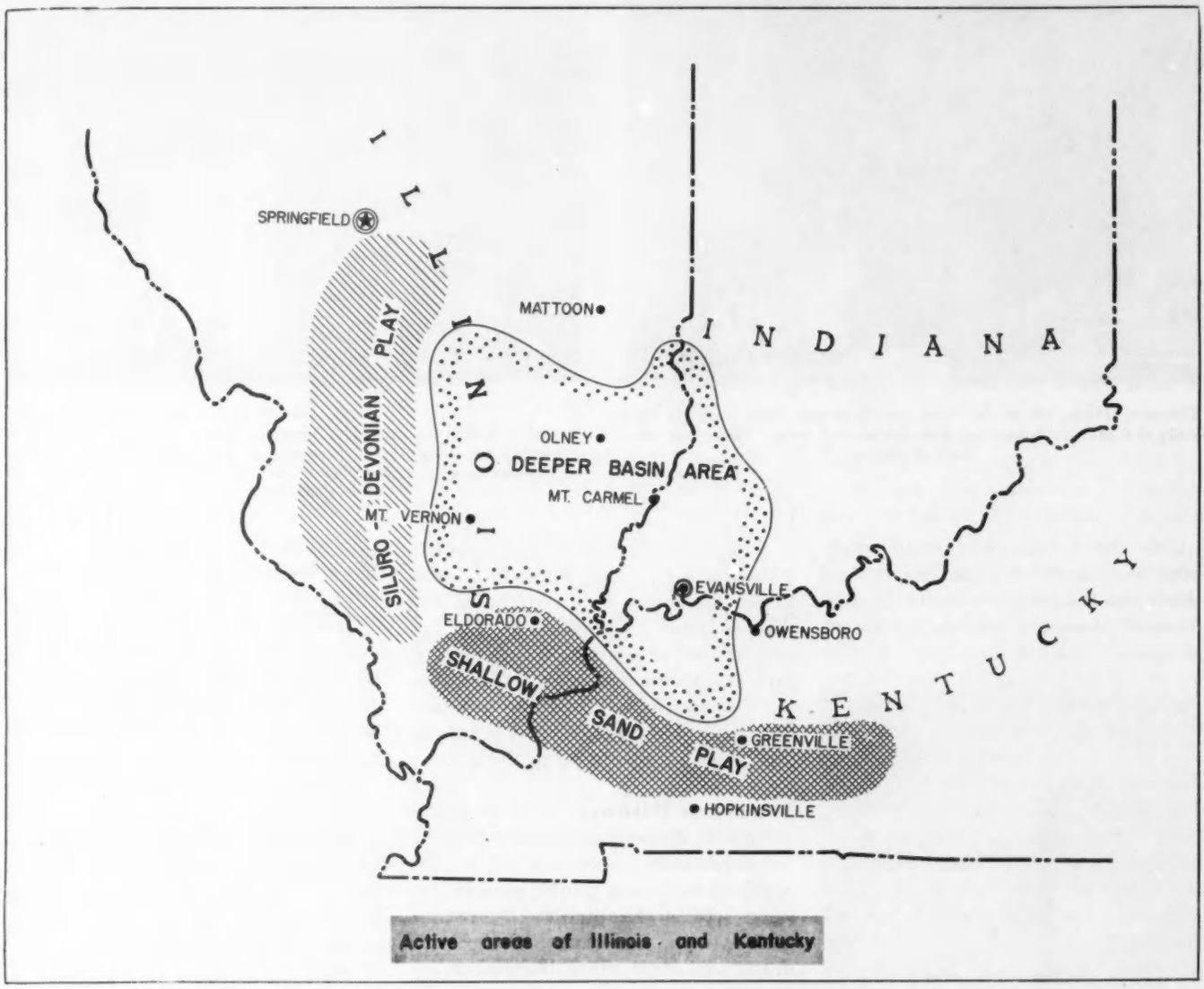
These areas offer numerous important advantages, including:

- Good price and market.
- Shallow depth.
- Quick payout.
- Absence of proration.
- Waterflood potential.
- Reasonable leasehold costs.
- Fair tax policies.
- Simple stratigraphic section.
- Availability of geological information.
- Unusually high number of electrical logs.
- Available pipe lines.
- Reasonable return on investment.

Aggressive independents, large and small, lead the shallow play, but more than a half dozen majors are active. Shell Oil Company has announced a 9000-foot basement test in western Kentucky. Illinois production in June this year was greater than in any other month since 1943. The shallow basin rims are the current oil field fairways. Fifteen of the 21 new pools found in Illinois last year were on the shallow rim; and of these, 11 were in Devonian or Silurian reservoirs—the greatest number of pre-Mississippian pools ever found in the state in any one year. Of the 15 new oil pools found in Kentucky during 1954, 5 were on the shallow south rim.

Recent successful exploration and development in the Eldorado field area of southern Illinois, in the Mt. Auburn area of western Illinois, and in the Apex area of western Kentucky highlight a new cycle in oil exploration of the Eastern Interior Basin. In the Eldorado field wells are completed in Waltersburg sand at the 2100-foot level for initial potentials up to 3000 barrels per day. In the shallow western Illinois area of Christian, Sangamon, Macon, Bond and Washington counties, new Silurian and Devonian discoveries are opening up important fields. In the Apex field area of Christian, Muhlenberg and Todd counties, Kentucky, good wells are being completed in Jackson and Benoist sands and McClosky lime at depths ranging from 500 to 1000 feet. The main pay is the Jackson sand, found at an average depth of 700 feet, which yields initial potentials up to 400 barrels per day.

During the first six months of 1955, 17 new oil pools and 3 new gas pools were found in western Kentucky. All of the gas discoveries and 9 of the oil




Active areas of Illinois and Kentucky

discoveries were on the shallow south rim. Through the middle of July, western Kentucky completions were 68 ahead of 1954. Illinois completions in the first half of 1955 were 273 ahead of last year, and of the 9 new pools discovered, 6 were on the shallow western rim. Five of these were in Silurian or Devonian; one was in Cypress sand at 400 feet.

The current successful exploration campaign in southern Illinois and Kentucky is in an area where faulting, sharp structures, igneous intrusives and associated tight reservoir rocks discouraged earlier exploration. Fracturing has made many of these rocks commercial oil reservoirs, whereas others yield commercial wells without fracture, shot or acid.

**Southern Illinois.** Two major structural trends are evident in southern Illinois. Along the Shawneetown-Cottage Grove fault system, the structural trend is west to northwest, and in the eastern and southeastern part the trend is northeast. The known dikes are confined to a belt about 15 miles wide and strike NW-SE. Most faults are the normal, high-angle type of small displacement, but displacements up to 2000 feet are known. Thrust faults are believed to be present in the area, and the Shawneetown fault having a known displacement of 3500 feet may be associated with thrusting.

These geological features with associated reservoir rocks, assumed to be extremely tight, have provided a mental hurdle to earlier exploratory thinking and exploration financing in the area, but recent discoveries have changed this attitude.

The Eldorado field was discovered in 1941, when two small wells were completed two miles northwest of the town of Eldorado. However, the rapid development of the field and the fast play in the area started in late 1954, when good Waltersburg sand pay was found 1½ miles northeast of town.

As of January 1, 1955, the Eldorado field had produced 553,942 barrels from its 43 wells. By the end of May, 1955, 90 additional field wells had been completed, and the accumulative production had risen to 2,226,241 barrels, representing a net of 1,672,299 barrels for the first five months of 1955. The 2100-foot Waltersburg sand is the main pay. However, Palestine, Tar Springs, Hardinsburg, Cypress, Paint Creek and Aux Vases sands are also productive. Some production comes from oolitic zones of the Aux Vases, O'Hara, Rosiclare and McClosky limestones. The depths of pays range from 1900 to 3100 feet. Many of the wells are drilled through an abandoned coal mine, which re-

Eldorado, Illinois, rig on fire from coal mine gas. Most Eldorado field wells are drilled through an abandoned coal mine. Three rigs have been destroyed.

*Photo by courtesy of The Carter Oil Company*

A rotary drilling rig and lease tanks in southern Illinois. The area is attractive to independent operators, as wells are relatively shallow and inexpensive, and investment can be recovered in comparatively short time.

quires the setting of a mine string. However, most of them reach total depth in less than two weeks, and some of them pay out in that length of time.

Kentucky gas well blows in. Volume of 15 million cubic feet from the Paint Creek sand at 732 feet.

Prolific production at Eldorado has caused a leasing and wildcatting campaign along the southern rim of the Illinois basin. Exploration activity has moved further south into the complex structural area than ever before. Subsurface and surface methods are used primarily. However, several geophysical crews are operating in the area.

**Western Illinois.** The structural trends in Western Illinois are NE-SW or north-south, conforming to the strike of the strata on the western rim of the basin. Faulting is uncommon, and anticlinal structures, stratigraphic traps, and reefs afford the main traps for oil and gas.

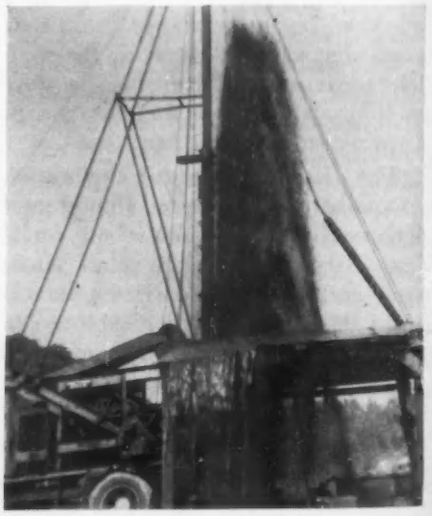
Trenton produces in anticlinal structures; Silurian produces in reefs and porosity pinch-outs; and Devonian produces on structure and in stratigraphic traps. Shallow Mississippian and Pennsylvanian sands produce on structures and in stratigraphic traps. In recent months significant new pools have been opened in Niagaran reef lime and Devonian sand. Silurian and Devonian production ranges in depth from 1700 feet in the Springfield and Marine areas to 2300 feet in the Woburn and Tilden areas.

**Western Kentucky.** Most of the earlier exploration and development in western Kentucky has been on the north edge of the western Kentucky basin and north of the Shawneetown-Rough creek uplift. Current exploration attention is focused on the shallow south rim, where the Chester and Lower Mississippian reservoir rocks have been found productive at from 500 to 1500 feet.

The area is laced by a system of east-west fault zones, which are intersected by numerous branch faults, trending NE-SW and NW-SE. The definite existence of thrust faulting in Muhlenberg County was established by a recent wildcat test.

Production in the Apex field comes mainly from a Jackson sand bar located on a north plunging structural nose. However, some other production in this area of Christian, Muhlenberg and Todd counties is controlled by faulting and folding.

The Apex field was discovered by random drilling in May, 1954. One year later 79 Jackson sand wells had been completed at an average depth of 700 feet. A majority of the wells are drilled with cable tools, because of the shallow depths, lower costs, and



Kentucky well goes "over the top." Flowing well in Apex Field.

satisfactory results. The section is a natural for this type of drilling as the casing program is simple. Most wells require only a joint of surface casing, possibly an intermediate string, and the oil string. Some are completed with only a short joint of surface casing and the oil string, which is rarely cemented. Some wells are completed natural, some are shot, and only a few are fractured.

**Lease Situation.** Acreage is rather tightly held in the areas near production, and prices paid have been abnormally high in many cases. However, in some outpost unleased areas, commercial leases can be taken for terms of 2 to 5 years for prices ranging from $2 to $15 per acre, dependent upon the available geological information and the competitive acquisition efforts of the operators. Most of the leases taken by the majors are of this type. However, the numerous independents who control most of the acreage now under lease usually take shorter term leases, subject to a drilling commitment, which often serves to reduce the leasehold costs somewhat.

Thus there is a rapid turnover of short term leases, and considerable land under lease one month becomes available the following. Land titles are usually simple, and royalty has not been sold widely. Although most of the wildcat drilling is done by independents, the majors are cooperative in furnishing dry hole money, farmouts, or acreage contributions.

At present there is a notable difference in the Kentucky and Illinois plays. Save for Shell Oil Company, which holds several large blocks, the majors own only a small percentage of the acreage now under lease in the rim area of western Kentucky. In Illinois the independents are still in the lead, but the majors hold a strong position in some areas.

**Economics.** Reasonable lease blocks minimize the capitalized cost in a drilling deal, and the bulk of the cost of a wildcat goes for intangible drilling expense and is written off the same year.

In western and southern Illinois rotary drilling is contracted for $3.50 to $4 per foot, and the cost of a well drilled and equipped runs about $12 per foot. Thus an average well at 2100 feet costs around $25,000. Oil sells for $2.90 per barrel, and return on investment is reasonable to exceptional.

Calculated on the basis of current prices of crude and development, the Marine field in western Illinois, producing from a Silurian reef, has returned more than $5 for every $1 invested. Payouts are fast in the Eldorado field, and the ratio of return to investment should be high. Here recoveries up to 400 barrels per acre foot are expected, and parts of the field may yield 12,000 barrels per acre of primary oil. Secondary recovery may equal the primary. In the general Illinois basin a primary recovery of 3000 to 4000 barrels per acre can be expected, with a secondary recovery of the order of three-fourths of this amount.

Cable tool drilling prices in western Kentucky are a little less than Illinois rotary prices, and wells are completed into the tanks for $10 per foot or less. The average 700-foot Jackson sand well at Apex costs $7000. Crude price is the same as in Illinois. Sand thicknesses vary from 10 to 30 feet, and the average effective pay is about 15 feet. Large volumes of gas are produced with the oil, and the bottomhole pressures are high for the shallow depths. Recoveries of 200 barrels per acre foot of primary oil and 250 barrels per acre foot of secondary oil are expected. Thus on the basis of five-acre spacing now in vogue, an average well in Apex field should yield 15,000 barrels of primary and 19,000 barrels of secondary oil for a total of 34,000 barrels. If flooding is started early, a return of 4 to 1 on the investment should be realized.

Independent operators headquarter mainly in Evansville, Ind.; Owensboro, Ky.; Mt. Carmel, Mt. Vernon, Olney and Mattoon, Ill. The majors active in the area are Sun, Phillips, Shell, Gulf and Sinclair in Evansville, Pure at Olney, The Texas Company at Salem, and Carter at Mattoon.

Any newcomer to the area will find a group of most cooperative and helpful independents and majors ready to assist in any justifiable deal. Electrical logs are run on a majority of the wells. Geological information is readily available and is promptly exchanged in scout checks, where all majors and almost all active independents and consulting geologists are represented. Independents and consultants team up in syndicates, each having a scout in check. This arrangement makes the cost of electrical logs and geological and production data quite reasonable.

Aside from scout checks, electrical logs are furnished by two commercial sources, and completion cards are supplied by another commercial service. One organization in Evansville furnishes geological maps and brings them up to date monthly as a part of its service. Geological base maps are also available in Mattoon and Tulsa. Two commercial oil reports giving fast, accurate information are published in Evansville. Up-to-date abstract maps of Illinois are supplied at Mattoon, and Kentucky land maps are available in Evansville, Louisville, and Owensboro.

Aerial photographs to any scale and the new series topographic maps on the same scale as the commercial land maps (1:24,000 - 1″ = 2000′) are available in Frankfort. Kentucky now has the most complete topographic map coverage of all the states on this scale, which is a big help in both land and geological work, particularly in surface geological mapping.

**—The End**

## About the Author

E. E. REHN is a native of Oklahoma and attended Kansas State, Wichita University and Ohio State, receiving his MS degree from the latter in 1942. Before becoming a consulting geologist and oil producer he worked for Magnolia Petroleum Company and Sohio Petroleum Company. He specializes in oil exploration in the Tri-State area and has been doing exploratory geological work there since 1942, when he went to Illinois as Sohio's first geologist when Standard Oil Company of Ohio became an oil producer. He has been a consultant since 1949.

# Hiring Is a Science

**Here is a foolproof way to improve your selection of new employes.**

**By HAROLD A. EDGERTON**
Richardson, Bellows, Henry & Co., Inc.
New York

CAREFUL SELECTION of personnel pays off. It may cost a little more, but the result of your investment will be more productive workers.

The procedure of selecting a new employe is basically the same whether the job is that of a roustabout, grocery cashier or machinist. In every instance, you should:

1. Find that a need does exist for additional personnel.
2. Set up the qualifications demanded of the new employe.
3. Establish promised and expected awards to insure that the "good" applicant will become an employe.
4. Identify persons who fit the qualifications.
5. Give the new employe a thorough program of induction training.
6. Evaluate and train the employe so he will be able to assume the responsibility of higher level positions.

The oil industry has stepped ahead in improving its information and procedures in all of these phases. However, there are still some groups which have not been able to carry on research programs necessary to develop custom-made measuring sticks for the selection of personnel. In fact, many companies are limited merely to identifying persons who fit the qualifications.

With or without the benefit of custom-fitted personnel tools, every employer tries to bring the best judgment he can bear on the selection of employes. He has learned methods of personnel selection from his own experience, from discussing the experiences of others, and from reading. Such methods may not be the most effective, but they have served.

The purpose of the following suggestions is to present some commonsense proved ways in which personnel selection may be improved. These improvements are the result of research and experimental trial which have been found generally applicable and worthwhile. Their use does not require that you add more specialists to your staff, but rather that your present personnel department sharpen up its tools.

Do you really need a new employe? Need for additional personnel is established by vacancies in present jobs, by the demands of increased or decreased work and by the equipment. Every organization needs to continuously study its work methods, flow of work and allocation of duties to insure a constant maximum of production per worker. At the same time you must be sure your work demands are sensible and workable. Carrying a larger personnel than you can keep effectively at work is wasteful.

**Do you know what type of person the job requires?** The specifications or requirements demanded of an employe for each particular job have developed through tradition, experience, legal requirements and preconceptions. In this area you have need for careful observation. You must separate fact from bias and study the characteristics of those who have been better performers as contrasted with those who have been below average in effectiveness.

The task includes examining the demands made on the employe by equipment, work conditions, tradition, level of competence required, kinds of work and associates. You must also evaluate the specific duties or tasks which comprise the job. On the other hand, you need to be aware of both the physical and psychological limitations of workers, and design your equipment and duties to such standards.

**What qualifications are necessary to find the right employe for the job?** Qualifications may be summarized under the following headings:

- **Physical requirements:** age, sex, height, weight, hearing, vision and health.
- **Legal requirements:** minimum age, licensing and citizenship.
- **Experience requirements:** Give an estimate of the applicant's skill and knowledge. Furnish evidence that the applicant has aptitudes for learning the job and progressing with it.
- **Educational requirements:** Obtain information on previous training

## Make your interviews pay off . . .

*The interview is the most abused method of obtaining additional information from prospective employes. It won't be if you get answers to questions such as these:*

1. **Does the applicant know what he needs to know about your job?**
2. **Will he fit in with your present employes on the job? (appearance, language, dress, expressed attitudes, reaction to people)**
3. **Will he be willing to fit in with your ways of working and your conditions of work?**
4. **Does he have a clear understanding of what you want done and the conditions under which it is to be done?**

Mr. H. was excited. He had the oil deal to end all deals. And he was no child when it came to such oil deals. It was a good deal. Mr. H. believed in its success for he had unbounded faith and optimism in his own ability to make it come out as he had planned. He had everything ready for us, and we could hardly keep him from signing right there and then.

We tried to slow him down, but he had the bit between his teeth and he was on the run. Finally we got him to listen, and we explained his deal to him from our point of view. We showed him the dangerous position he was needlessly putting himself in. Our faith in him was high, but we couldn't see a man put a noose around his own neck.

So we knocked off a lot of what he would have had to do. We brought his part down to what you could reasonably expect a man to do. We didn't lend him as much as he had wanted, but what we did lend him was fully adequate and on terms a great deal easier and more favorable to him than he had set up for himself.

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E. O. BUCK, VICE PRESIDENT, OIL LOAN DEPARTMENT

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which has direct relationship to the job duties. Also study overall background which will serve as a general level of ability screen.

• **Special aptitudes:** Manual dexterity, sense of rhythm, memory for details. Ability to think in terms of three-dimensional space may be required by the job.

• **Personal qualifications:** Emotional stability, ability to mix easily with people, good telephone manners, willingness to work in oil or dirt, or to be away from home and family for extended periods.

• **Other qualifications:** Ownership of automobile, etc.

Some of the specifications are obvious, while others cannot be identified precisely without resorting to research procedures. Physical and legal requirements are perhaps the easiest to establish. The experience and educational requirements can be given fairly firmly on the basis of good judgment. Specific aptitudes and personal qualifications are the most difficult to pin down.

Even harder to establish is the basic reality of each qualification. Too often qualifications grow up and become accepted because they are traits or qualifications of a successful or well-liked employe, and may have little or no relationship to success on the job. Ultimately, hiring specifications must be tested under controlled conditions against performance on the job.

Identification of persons who meet the established qualifications can be improved in a number of ways. Every organization uses some of these improvements, but very few use all of them. It is interesting to note that industry has been quite willing and anxious to test the effectiveness and efficiency of selection procedures, but has often failed to see that, retroactively, such tests also apply to the hiring specifications. It is not uncommon practice to set the specifications higher than those really required for the job in an attempt to get better qualified people.

Some of the qualifications of an applicant can be better evaluated by carefully checking the following items.

**1.** Most of the physical qualifications are relatively simple to measure. However, such items as health, ability to withstand extreme temperatures, etc., may require careful consideration of experience and previous work conditions.

**2.** About the only way you can determine whether an applicant meets the legal requirements for a job is to inspect the appropriate documents: licenses, birth certificate, school certificates, discharge papers, etc.

**3.** Experience requirements may be evaluated from several points of view. The experience record should furnish definite answers to some questions. Too often a glance through the experience record gives little more information than a general impression that the applicant has "been there." It is impossible to get the full message conveyed by such a record. Here are some of the questions you should ask when checking an experience record:

a. Did the jobs held require the kind of skills and knowledge needed for your job?
b. Does the record show any evidence of growth, learning, promotion?
c. Is there evidence that any of the special aptitudes were needed to do the job?
d. What kind of person does the record characterize? Stable? Wanderer? Dependable? Comer?


**About the Author**

HAROLD A. EDGERTON, vice president of Richardson, Bellows, Henry & Company, Inc., is responsible for work in improving selection of employes, developing methods for evaluating on-the-job-performance and special training problems. Formerly professor of psychology at Ohio State University and director of their vocational counseling services, he also was chief of the statistical division of the Occupational Research Program of the U. S. Employment Service. He has been with RBH since 1947.


In addition to what the experience record shows about skills and knowledge, some questions should be asked in the interview to verify the presumed job knowledge and skill. Such questions may have to do with the use of equipment or tools of the job, or with time needed to perform certain job duties, knowledge of new procedures or developments in the field, or acquaintance with persons who should be known to the prospective employe through his past employment.

You should also request a report from the previous employer—a recommendation or reference. The most useful recommendations are obtained by direct conversation with a previous employer. He is more willing to describe the work performance of a former employe accurately and honestly if he can do it orrally. A letter of inquiry asking specific questions regarding the employe is about second in effectiveness. A general reference inquiry is worth little, and a reference letter carried by an applicant at best is equal to a poor grade of waste paper.

The interview is a much used and abused method for getting additional information about a prospective employe. Most personnel people believe they are pretty good interviewers, but evidence does not support the contention.

Before you use this aid to selection, you should spell out what you expect it to do for you. In fact, you will waste time in an interview unless you know specifically what you want to find out, and know in detail what questions and answers will give it to you. Do not ask for information already available in the application blank. Be sure that the applicant does most of the talking. It is his attitudes, opinions and knowledge that are to be studied and evaluated.

A final way to improve selection is to use your probationary period as part of the selection process. Many times selection is thought to be completed when an applicant accepts a job. However, there is still more information which can be obtained by watching his on-the-job performance.

The probationary period, usually ranging from 30 days to a year, offers a perfect opportunity for you to observe the success of these employment techniques before the new man is put on your permanent payroll.

—**The End**

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# Automation—Glamor Word of Industry

**The idea is as old as civilization. The only thing new is the name and the promising future.**

**By M. L. POWERS,** Director of Business and Industrial Services, University of Oklahoma, Norman, Okla.

MENTION AUTOMATION, and you will have as many different reactions as you have people.

Some say it is good. Others say it is bad. Some claim this "glamor word" will create a serious unemployment problem. Others say it will increase employment.

Whatever your reaction, there is one thing certain—automation is not new. In fact, all that is new is the word. Automation is the continuation of an evolution that has been going on since the beginning of civilization. Man, being somewhat lazy, is constantly trying to find better and easier ways to provide material goods for his family. That better way requires a continual improvement in the use of tools and equipment.

We are now enjoying the highest standard of living that we, or anyone else in the world, have ever known. We maintain these standards by working only 40 hours a week. Why? Because we have learned how to make more effective use of time and effort with the help of automatic machines. As automation continues to improve, what will the future bring?

**Displaced Jobs.** Increased use of automatic machines will replace workers, it's true. However, we have been replacing people with labor-saving machinery since the industrial revolution began over 50 years ago. Take the loom, for example. One loom weaves much more cloth than a man, so naturally thousands of people have lost that particular type of job. In fact, machinery has thrown people out of work to the extent that we now have only 65 million on company payrolls —the largest employment figure ever recorded in the U. S.! How do we explain this?

The types of jobs displaced by machinery usually fall into two groups:

- *The single skill or operative job.* It is a highly repetitive job and requires very little mental effort on the part of the operator. He really doesn't mind losing the job anyway. The interest factor is very low.
- *The very heavy job.* Wherever possible, a machine is devised that will pick up and handle heavy items or do heavy work, thus relieving thousands of men from back-breaking labor.

**New Jobs Created.** As the "drudgery" and "back-breaking" jobs disappear, automation will provide new job opportunities in the following fields of work:

1. More machines will be manufactured. Tool designers will be needed to create the machinery. Tool makers will be needed to manufacture the machinery. Machinists will be needed to construct the machinery.
2. More skilled workers will be needed to install machinery in the factory and in the home.
3. There will be an increased demand for trained maintenance personnel. As a typical example, there is a plant which employs 24 electricians. These men have been with the company for several years. New automatic electronic equipment has been installed and it now develops that only three of the men know how to adjust or repair the new machinery. There are no jobs for the remaining 21 men and there is no source for additional men to maintain the new equipment. The company solved the problem by upgrading all the men who had the aptitude to the point where they could service and maintain the equipment.

**New Roles for Management.** Along with automatic machinery will come new responsibilities for management. Work needing supervision is becoming more complicated making it necessary for management to keep

### *Birth of a word . . .*

**You won't find the word "automation" in the dictionary. It is too new. The word was created a few years ago while a young graduate student, John Diebold, was writing a report on the use of self-regulating machines in factories and offices. He discarded the dictionary term "automatization" as too clumsy and made up his own word "automation." Diebold's verbal shortcut is now the accepted label for a new industrial era. Diebold, who has become a leading expert in the automation field, has this to say about the word's meaning: "When machines do a man's work, that's mechanization. When they do his work and control their own operations as well, that is automation."**

abreast of new technical developments.

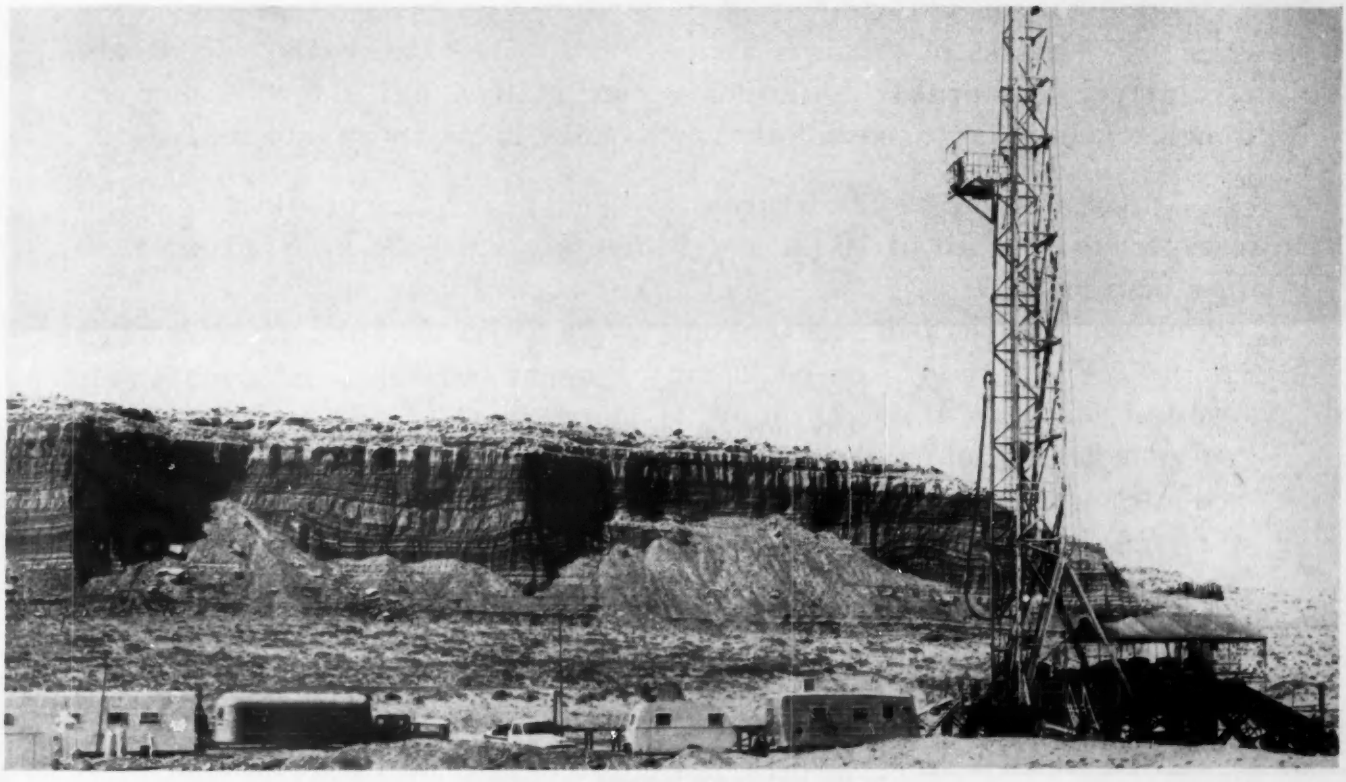
The men who report to management will be doing work of a more technical nature. The result will be fewer men to supervise—but those few will need closer supervision.

With the work becoming more technical, the supervisor will be required to spend considerably more time training men for their jobs. Each man's work will tend to become more of a specialty. The jobs will require a high degree of skill and the supervisor is the only logical source for the employee to seek this technical know how.

There will be a continuing need for the improvement of process and procedure to maintain competitive position. This requires not only increased effort and ability on the part of management, but also the support of each man on the job. There must also be close cooperation and coordination of activity with all staff departments, especially engineering, research and development. Other departments will also play a vital role in automation. Certainly, marketing will continue to be a very important department—and by all means accounting, for we must always know where we have been if we are to orient ourselves to the future—the promising future of automation.

**ACKNOWLEDGMENT**

Excerpted from a speech by M. L. Powers, Director of Business and Industrial Service, University of Oklahoma, at Regional meeting, Natural Gasoline Association of America, Sept. 29, 1955.



Shell Oil Company's gas discovery well in the Monument Valley area has made . . .

Photo courtesy Shell Oil Company

# Arizona an Oil and Gas Producing State

Interest in Arizona's possibilities during the past year was considerably heightened by Shell Oil Company's discovery of natural gas at their wildcat in colorful Monument Valley area, on the southern edge of the Paradox basin, in northeastern Arizona. The discovery, East boundary Butte No. 2, shown above, flowed gas in excess of 2 million feet daily rate, along with some condensate. The well signified Arizona's entry as No. 30 on the list of oil producing states of the nation. The well, with total depth of 6339 feet, produces from the Hermosa section of the Pennsylvania, from perforations at 4540-4585 and 4650-4690 feet.

Importance of the Shell Oil Company discovery in Arizona has been enhanced recently by the finding of oil and gas by Humble Oil & Refining Company in a well located about three-quarters of a mile southwest of the Shell discovery. Humble's Navajo Tribal No. 1 recently was shut in after having flowed 65 barrels of 38 gravity crude and 4.4 million cubic feet of gas daily through ½ inch choke from perforations at 4806-4816 and 5570-5582 feet. The Humble well is 15 miles west of Carrizo, Arizona.

# Oil Industry Outlook for '56 Good

- **Volume of business to expand, as demand for oil is expected to increase 4 to 5 percent.**
- **Stocks of products are in relatively favorable balance, through benefit of large consumption.**
- **Capital expenditures are expected to be about 10 percent larger than in 1955.**
- **Modest improvements in earnings are anticipated, possibly averaging about 5 percent.**
- **Dividends will remain conservative, but a few further increases in payments are likely.**
- **Petroleum demand in free areas outside U. S. expected to rise about 8 percent.**

THE OUTLOOK for the oil industry as it enters 1956 is bright. Good results are promised by the continuing upsurge in demand for oils. It is likely that oil use will be up 4 percent to 5 percent over 1955. That would be in line with the historical pattern of growth. For 1955 the gain is estimated at better than 7 percent over the retarded 1954 experience.

The continuing rise in consumption of petroleum products is contributing to the long-range increase in earnings of oil companies. Heavy capital needs of the industry will keep dividends conservative relative to earnings. But the 27½ percent depletion allowance is of help.

**Gains Foreseen.** Demand in 1955 is estimated at an average of about 8,300,000 barrels daily in the U. S. Demand in 1956 may average 8,650,000 barrels daily or better. It should reach a new high, in any event.

Inventories of products are in reasonably good balance. The rapid rise in demand for distillate heating oils of some 9 percent in the first nine months of 1955 prevented excessive accumulation of stocks. Gasoline inventories similarly were held down by high consumption, which rose 9 percent in the first eight months of 1955.

Capital expenditures in 1955 are estimated about 10 percent larger than a year earlier. A further rise of about 10 percent is projected for 1956.

Earnings gains for major oil companies in 1955 are estimated at about 15 percent on average. For 1956, earnings prospects are good. Modest improvement is likely for most companies, possibly about 5 percent on a year-to-year basis. Dividend increases in a few instances are likely in 1956, despite heavy capital needs.

**Demand Strong.** The demand for petroleum products in 1955 outpaced expectations. A year-to-year gain of over 7 percent in domestic demand is estimated for all of 1955, compared with the retarded 2 percent of 1954. U. S. domestic demand in 1956 may approximate 8,650,000 barrels daily, another new high, comparing with an estimated 8,300,000 barrels daily in 1955 and 7,750,000 barrels daily in 1954.

The sharper than average rise in 1955 partly reflects the lag in demand in the preceding year. A smaller increase in domestic demand in 1956 would reflect mainly a return to the historic pattern of growth for the industry, at between 3 percent and 5 percent.

In free areas outside the U. S., demand in 1955 is estimated around 5,300,000 barrels daily, about 11 per-

*WORLD OIL's annual Forecast-Review Issue will be available on February 15. It is the book that has become known through the years as the most complete annual analysis available on the oil industry's various economic phases. Don't miss it!*

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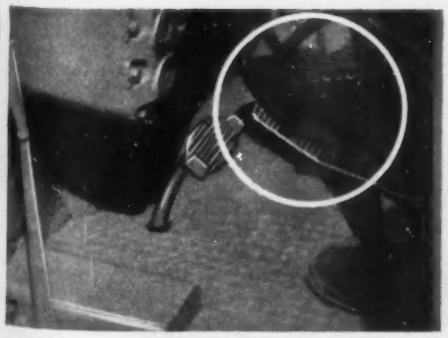
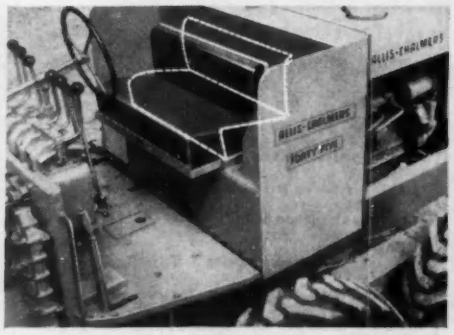
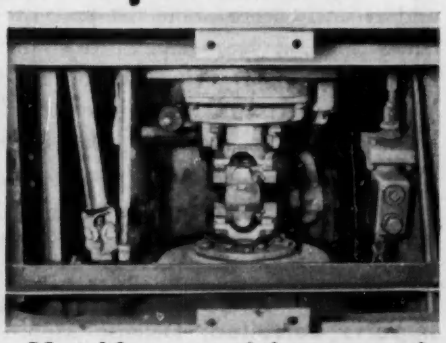
**. . . less maintenance . . . easier and better operation!**



**New accelerator-decelerator pedal** lets the operator increase or decrease engine speed with his foot — without changing his hand throttle setting.



**"Box seat" comfort and visibility.** Foam-rubber seat adjusts for sit-down or stand-up operation. Flat, roomy platform has tapered corners for top blade visibility.



**Matchless servicing accessibility.** Unit construction permits easy service or removal of clutch, transmission or engine without disturbing adjacent parts.

cent larger than a year earlier. The further rise in demand outside the U. S. in 1956 is projected at around 8 percent to about 5,750,000 barrels daily. Per capita consumption in areas outside the U. S. is still relatively low. The growth rate in consumption in such areas is expected to continue sharper than in the U. S.

**Inventories in Balance.** Because of continuing gains in consumption, inventories have held in fairly good balance. Recently, supplies of products were equal to about 60 days' consumption, compared with about 64 days' a year earlier, and 61 two years earlier. Inventories of gasoline at primary levels (refineries, bulk stations and in pipe lines) in October were about 2 percent larger than a year earlier, which in turn reflected considerable correction from the disproportionately high level some months previously.

Despite the high rate of refinery runs, which averaged about 7,500,000 barrels daily in October, or about 9 percent more than a year earlier, distillate heating oil inventories at primary levels held in fair balance relative to demand for this product, which also rose 9 percent in the first nine months. Prices were raised in eastern areas late in November. Prospects for this division will depend greatly on the weather in the months ahead. Assuming normal temperatures, demand for light heating oils may increase about 9 percent on a year-to-year basis over the near term, reflecting the greater number of oil burners in use.

Inventories of heavy heating oils were reduced in the past 12 months, and recently were about 19 percent below those a year earlier. Most of the improvement took place on the West Coast. Inventories in eastern areas have risen recently, but, with refineries continuing to reduce residual yields, expectations are that stocks of heavy heating oil will not become excessive.

**Imports Curtailed.** Defense Mobilizer Fleming took steps to bring about some curtailment of imports of both crude and products in October. Importers were requested to reduce by 7 percent the schedules of imports for the next six months. The proposed reduction, however, does not affect Venezulan and Canadian crude. The Middle East will be affected primarily. However, the impact on Middle East producers should be relatively small, since a reduction of 7 percent in U. S. imports would be fractional in terms of total Middle East production, and would be diverted mainly to Europe and areas east of Suez.

The President has the power to curtail imports if found necessary for national defense. Since the U. S. accounts for over 60 percent of world demand, and is producing reserves at a much higher rate than areas outside this country, it is difficult to make out a case for producing domestic reserves at a materially higher rate. The easing of the pressure of imports on the domestic supply picture, nevertheless, should be helpful to domestic producers, indicating a firmer price structure.

**Refinery Spreads Improved.** The improved price structure for refined products contributed to improvement in the spread between crude prices and refinery realizations in 1955. Refinery spreads recently were the best since late 1952. Provided refinery runs are held in line with consumption, refinery spreads should remain reasonably close to current improved rates.

Historically, improved prices for petroleum products have been followed by periods of too high refinery runs, bringing over-supplies and weaker prices. The slight curtailment of imports is a strengthening factor in the price picture, coupled with the high rate of consumption. During the heating season, of course, the weather will have an important bearing on the supply-demand relationship, and on prices.

**Earnings Outlook Good.** Based on current prospects, expectations are that the strong upward tide in earnings of oil companies will carry through much if not all of 1956. A strong element of support is the rapid rise in demand in free world areas outside the U. S. The importance of these areas to the major oil companies is seen, for example, from a look at the internationals. In the case of Standard Oil Company (New Jersey), sales outside the U. S. account for about 60 percent of consolidated revenues. The proportions are smaller in the case of The Texas Company, Standard Oil Company of California, and Socony-Mobil Oil Company, but are probably above 40 percent. The proportion in the case of Gulf Oil Corporation is high because of sales from Kuwait.

Earnings of leading oil companies in 1955 are estimated as much as 15 percent higher on average than in 1954. The widest gains are expected to be reported by the international oils, such as Standard of New Jersey, Royal Dutch, Gulf, Texas, and Socony. The domestic integrated units, such as Standard Oil Company (Indiana), depressed in 1954, should report good gains for 1955. Shell Oil Company is an instance where reported earnings will be lower, although "cash earnings" may be up 15 percent or more.

The outlook points to continuance of favorable earnings comparisons in 1956. Crude production should rise further, reflecting the continuing increase in demand and some easing of pressure from imports. Earnings should rise commensurately. Earnings of integrated companies likewise are expected to improve further, probably reaching new highs.

Dividends in the main will remain conservative. A few further increases in dividends are considered likely.

ACKNOWLEDGMENT

This is an excerpt from a recently released analysis of the oil industry by Standard & Poor's Corporation, 345 Hudson Street, New York 14, N. Y. The complete report is qutie comprehensive, embodying pertinent statistics and analyses of numerous oil companies.

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By **RAY L. DUDLEY,** Publisher, and **WARREN L. BAKER,** Editor

# Too Much Gasoline Being Made

**THE INDUSTRY NEEDS** to reduce crude runs to U. S. refineries and also adjust refinery yields to produce more distillate fuel oil and less gasoline. Otherwise, far too much gasoline is going to be added to stocks during the remaining winter months. This would mean serious trouble for the industry next spring and summer.

Record runs to refinery stills have resulted in large production of motor fuel. Consequently, gasoline inventories have increased sharply. Unless the rate of growth is curbed during the next three months, stocks of gasoline are certain to become excessive before any seasonal increase in consumption takes place.

This is the only dark cloud on the industry's horizon. Cold weather has caused heavy drafts on distillate stocks despite high refinery output of this product. Peak crude runs to refinery stills has kept stocks of crude oil at favorable levels despite near record production volumes.

•

**GASOLINE STOCKS** have increased very rapidly in recent weeks. The rate of growth is much larger than a year ago. Consumption of gasoline will remain retarded until April. Therefore, if recent trends are continued stocks of motor fuel will reach very high levels by spring.

Steps need to be taken to curb additions to gasoline stocks. The way of doing this is to reduce refinery runs and to adjust refinery yields to produce more distillate fuel oil and less gasoline.

Inventories of gasoline reached 158⅓ million barrels on December 9, an increase of 6½ million barrels since the first of November. At this level they were nearly 8 million barrels greater than at the corresponding period of 1954, although they were only 2 million barrels larger than a year ago at the beginning of November. During the same period of 1954, gasoline inventories grew by only 1 million barrels. Additions to motor fuel stocks during the next three months should be held much closer to year ago levels. They already are 8 million barrels above last year and the spread should not be increased above this margin.

Higher refinery crude runs have resulted in the production of gasoline averaging 307,400 more barrels per day between November 1 and December 9 than in the same period last year. If the increase in gasoline output had been held to half of this amount, about 150,000 barrels daily, enlarged consuming rates would have prevented any additions to stocks since November 1.

•

**U. S. DISTILLATE FUEL STOCKS,** on the other hand, moved into an improved position despite high refining operations. Cold weather and a larger number of furnaces in use boosted the consumption of heating oils to the point that drafts on distillate fuel inventories have been heavier than last year, although output of this product averaged 118,500 more barrels per day between the first of November and December 9 than a year ago.

On the later date distillate fuel stocks totaled 134½ million barrels, a decrease of 17⅓ million barrels since November 1. If cold weather continues to prevail, inventories of distillate will be reduced to desirable levels by the end of the heating season. Therefore, the industry's lone economic worry is that of preventing the accumulation of too much gasoline.

•

**HIGH CRUDE RUNS TO STILLS** are largely responsible for the excessive growth in gasoline stocks. Runs to stills have averaged 7⅔ million barrels daily between November 1 and December 9, a gain of 679,000 barrels over last year's rates. This constitutes a gain of 9.7 percent, which is too large an increase.

The yields of products also have not been properly adjusted for this season of the year. There has been a greater growth in output of gasoline than in distillate fuel oil. Between November 1 and December 9, the industry manufactured 8.9 percent more gasoline and 7.5 percent more distillate oil than during the corresponding period of a year ago.

The industry can overcome all the dangers that it is now creating by increasing the yield of distillate fuel oil, reducing the yield of gasoline, and curtailing crude runs to stills. Any action along these lines will prove most helpful.

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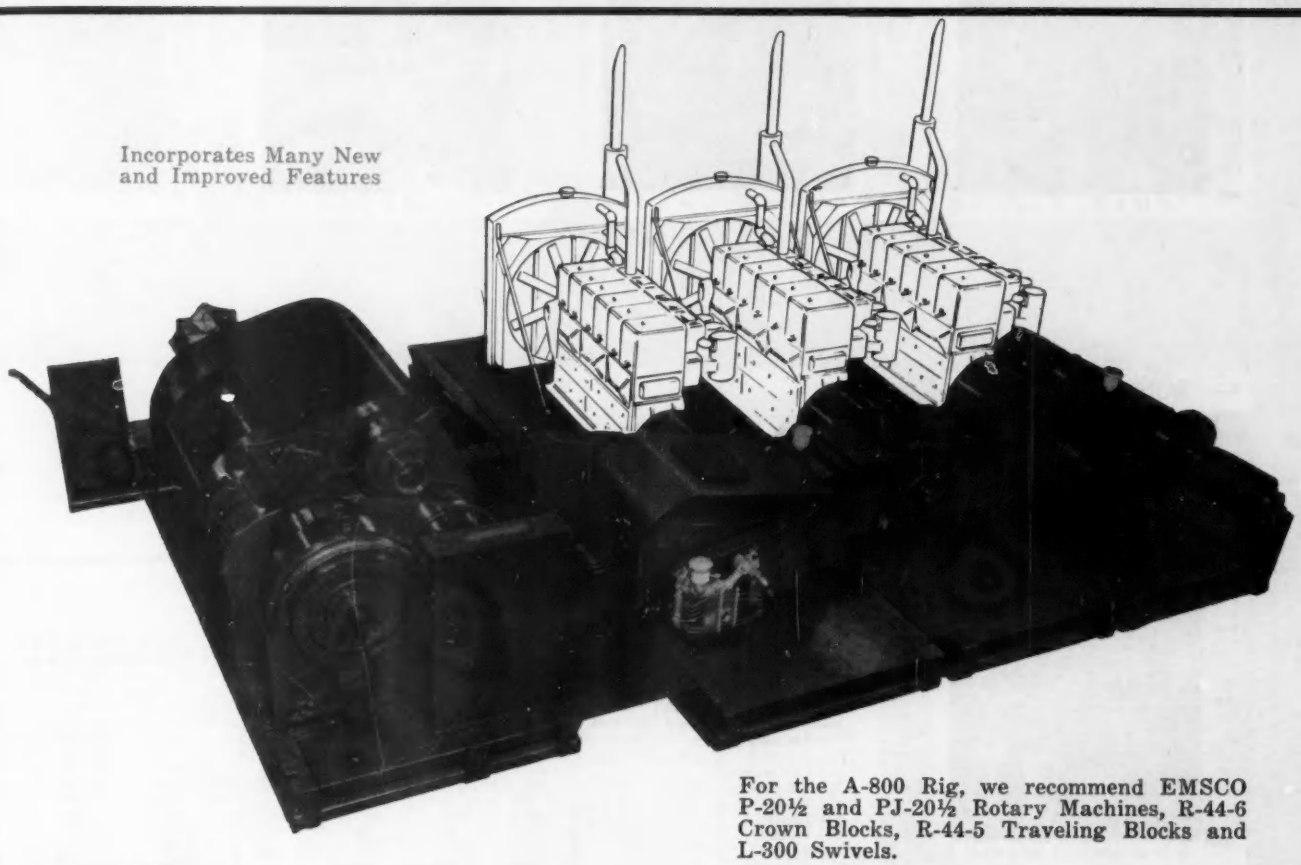

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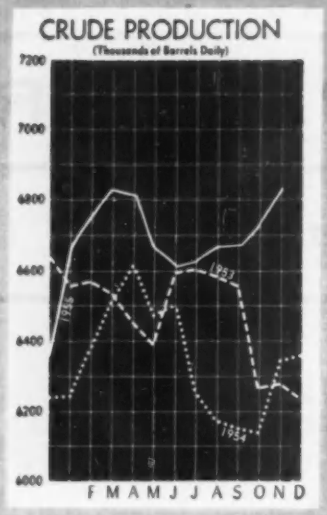
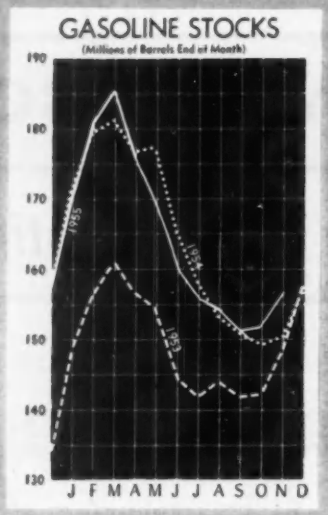
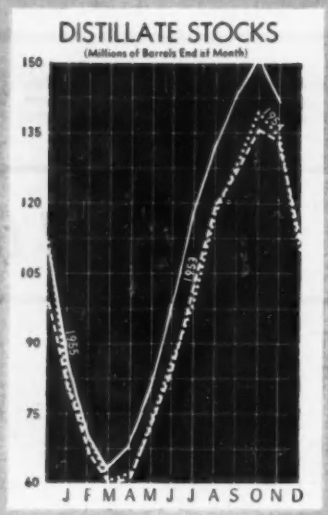
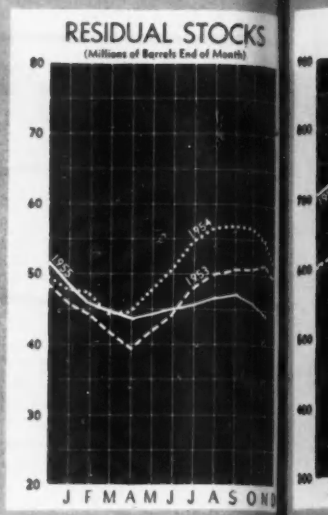
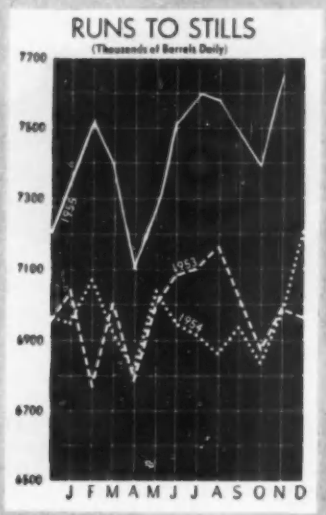
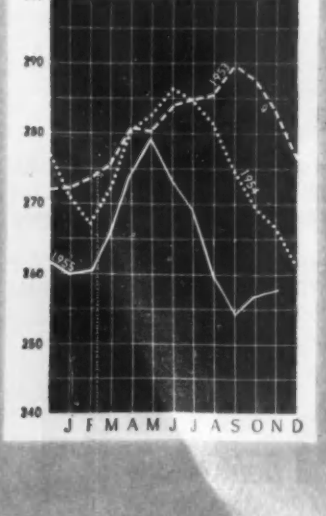



# Petroleum Trends in U. S. . . .

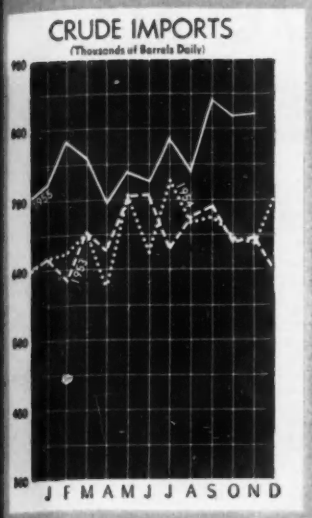
**By CECIL W. SMITH,** WORLD OIL Staff

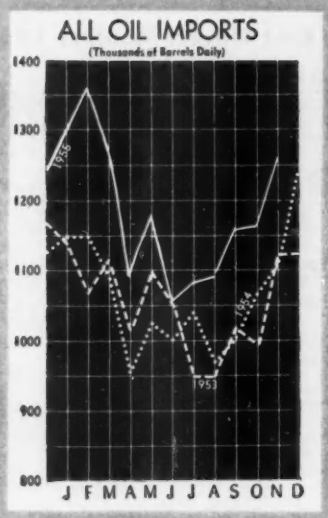
## U. S. Crude Production by States

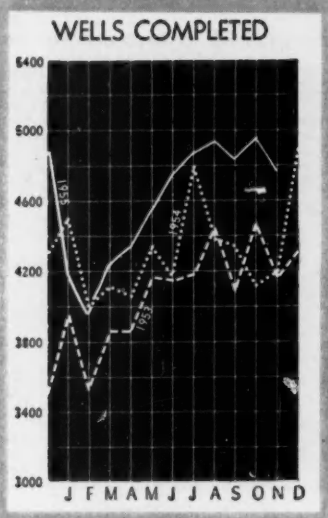
(THOUSANDS OF BARRELS)

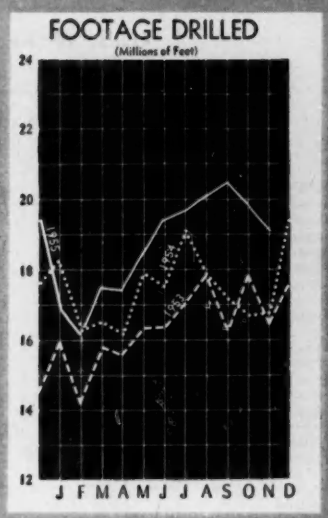
| STATE or DISTRICT | DAILY AVERAGE PRODUCTION Nov., 1955 | Oct., 1955 | Nov., 1954 | % Diff. Nov. '55-'54 | TOTAL PRODUCTION First Eleven Months 1955 | 1954 | % Diff. '55-'54 |
|---|---|---|---|---|---|---|---|
| Alabama | 4.2 | 4.1 | 4.1 | + 2.4 | 1,259 | 1,455 | — 13.5 |
| Arkansas | 74.3 | 73.6 | 79.7 | — 6.8 | 25,932 | 26,811 | — 3.3 |
| California | 971.8 | 975.5 | 957.9 | + 1.5 | 324,624 | 326,034 | — 0.4 |
| Colorado | 149.9 | 151.0 | 124.7 | + 20.2 | 46,248 | 37,293 | + 24.0 |
| Florida | 1.4 | 1.4 | 1.4 | ..... | 448 | 504 | — 11.1 |
| Illinois | 228.5 | 231.7 | 200.6 | + 13.9 | 74,792 | 60,804 | + 23.0 |
| Indiana | 29.5 | 29.9 | 30.7 | — 3.9 | 10,016 | 10,257 | — 2.4 |
| Kansas | 326.9 | 326.4 | 330.3 | — 1.0 | 110,920 | 109,235 | + 1.5 |
| Kentucky | 43.0 | 42.7 | 39.7 | + 8.3 | 13,835 | 12,574 | + 10.0 |
| Louisiana | 762.8 | 753.9 | 644.8 | + 18.3 | 243,333 | 225,457 | + 7.9 |
| North Louisiana | 116.2 | 115.8 | 108.5 | + 7.1 | 39,617 | 37,447 | + 5.8 |
| South Louisiana | 646.6 | 638.1 | 536.3 | + 20.6 | 203,716 | 188,010 | + 8.4 |
| Michigan | 32.0 | 31.1 | 32.5 | — 1.5 | 10,443 | 11,009 | — 5.2 |
| Mississippi | 110.2 | 107.5 | 91.9 | + 19.9 | 33,768 | 30,684 | + 10.1 |
| Missouri | 0.2 | 0.2 | 0.2 | ..... | 61 | 73 | — 16.4 |
| Montana | 41.5 | 40.8 | 40.6 | + 2.2 | 14,170 | 12,340 | + 14.8 |
| Nebraska | 28.2 | 28.6 | 21.3 | + 32.4 | 8,602 | 6,718 | + 28.0 |
| Nevada | 0.2 | 0.1 | 0.2 | ..... | 57 | 26 | +119.2 |
| New Mexico | 228.4 | 226.4 | 222.6 | + 2.9 | 74,508 | 68,587 | + 8.6 |
| Southeast New Mexico | 227.0 | 225.0 | 219.2 | + 3.6 | 73,656 | 67,881 | + 8.5 |
| Northwest New Mexico | 1.4 | 1.4 | 2.8 | — 50.0 | 852 | 706 | + 20.7 |
| New York | 10.3 | 10.4 | 8.7 | + 18.4 | 2,843 | 2,990 | — 4.9 |
| North Dakota | 33.6 | 20.5 | 22.1 | + 52.0 | 9,799 | 5,186 | + 89.0 |
| Ohio | 12.2 | 12.7 | 11.0 | + 10.9 | 3,941 | 3,492 | + 12.9 |
| Oklahoma | 555.9 | 543.7 | 492.3 | + 12.9 | 183,347 | 170,950 | + 7.3 |
| Pennsylvania | 20.1 | 22.0 | 22.7 | — 11.5 | 7,640 | 8,410 | — 9.2 |
| South Dakota | 0.1 | 0.1 | 0.1 | ..... | 28 | 30 | — 6.7 |
| Tennessee | 0.1 | 0.1 | 0.1 | ..... | 15 | 15 | ..... |
| Texas | 2,882.5 | 2,815.0 | 2,698.0 | + 6.8 | 958,050 | 897,436 | + 6.8 |
| Dist. 1—South Central | 54.3 | 50.6 | 43.7 | + 24.3 | 17,074 | 14,093 | + 21.2 |
| Dist. 2—Middle Gulf | 159.3 | 152.0 | 141.2 | + 12.8 | 56,413 | 47,656 | + 5.8 |
| Dist. 3—Upper Gulf | 433.2 | 431.9 | 430.7 | + 0.6 | 150,176 | 146,397 | + 2.6 |
| Dist. 4—Lower Gulf-S.W. | 244.0 | 241.9 | 233.9 | + 4.3 | 81,397 | 81,189 | + 0.3 |
| Dist. 5—East Central | 49.0 | 51.2 | 43.5 | + 12.6 | 16,206 | 14,787 | + 9.6 |
| Dist. 6—Northeast | 349.1 | 340.9 | 325.3 | + 7.3 | 115,131 | 113,437 | + 1.5 |
| Dist. 7-B—North Central | 149.1 | 149.1 | 129.3 | + 15.3 | 47,734 | 42,546 | + 12.2 |
| Dist. 7-C—West Central | 174.1 | 169.2 | 176.6 | — 1.4 | 60,741 | 60,097 | + 1.1 |
| Dist. 8—West | 965.7 | 932.2 | 850.5 | + 13.5 | 313,012 | 284,243 | + 10.1 |
| Dist. 9—North | 214.6 | 205.8 | 190.2 | + 12.8 | 66,887 | 62,452 | + 7.1 |
| Dist. 10—Panhandle | 90.2 | 90.2 | 84.2 | + 7.1 | 29,531 | 27,693 | + 6.6 |
| Utah | 4.9 | 6.3 | 5.0 | — 2.0 | 1,918 | 1,716 | + 11.8 |
| Virginia | 0.1 | 0.1 | 0.1 | ..... | 15 | 9 | + 66.7 |
| West Virginia | 6.6 | 6.4 | 7.7 | — 14.3 | 2,154 | 2,680 | — 19.6 |
| Wyoming | 272.1 | 270.0 | 255.2 | + 6.6 | 91,379 | 85,335 | + 7.1 |
| Total United States | 6,831.5 | 6,732.2 | 6,345.6 | + 7.7 | 2,254,145 | 2,118,095 | + 6.4 |

**Source:** Bureau of Mines and API. Texas districts data from API and dc not necessarily agree with State totals.



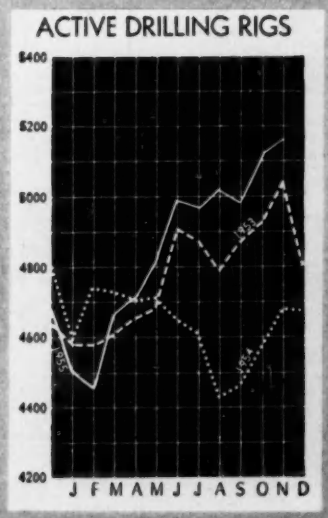

- **Active drilling rigs at 4-year high**
- **Crude output greatest since April**
- **Oil imports continue to climb**

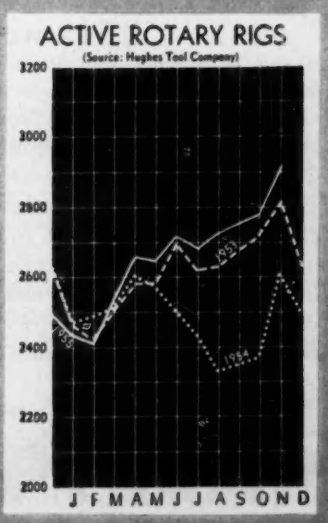
## Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

| MONTH | CRUDE OIL | | | GASOLINE | | DISTILLATE FUEL | | RESIDUAL FUEL | | DAILY IMPORTS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production Daily | Runs to Stills Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Crude Oil | Total Oils |
| 1953: | | | | | | | | | | | |
| August | 6,583 | 7,163 | 285,352 | 3,592 | 146,050 | 1,437 | 119,542 | 1,222 | 50,007 | 672 | 946 |
| September | 6,557 | 7,023 | 289,614 | 3,521 | 144,184 | 1,448 | 126,709 | 1,203 | 50,516 | 692 | 1,013 |
| October | 6,262 | 6,872 | 287,541 | 3,437 | 144,495 | 1,462 | 135,409 | 1,184 | 50,820 | 639 | 990 |
| November | 6,277 | 6,987 | 283,021 | 3,528 | 150,747 | 1,463 | 133,381 | 1,223 | 51,267 | 648 | 1,120 |
| December | 6,238 | 6,964 | 276,676 | 3,628 | 159,949 | 1,441 | 111,944 | 1,247 | 49,370 | 598 | 1,121 |
| 1954: | | | | | | | | | | | |
| January | 6,240 | 6,947 | 270,811 | 3,431 | 171,704 | 1,550 | 81,044 | 1,271 | 47,474 | 617 | 1,143 |
| February | 6,379 | 7,068 | 266,918 | 3,476 | 179,950 | 1,545 | 70,390 | 1,241 | 47,119 | 621 | 1,144 |
| March | 6,507 | 6,923 | 271,867 | 3,375 | 181,297 | 1,458 | 60,270 | 1,168 | 44,249 | 654 | 1,088 |
| April | 6,615 | 6,811 | 280,310 | 3,404 | 177,006 | 1,374 | 61,721 | 1,140 | 44,362 | 574 | 950 |
| May | 6,471 | 7,038 | 282,250 | 3,482 | 177,606 | 1,372 | 73,581 | 1,148 | 47,009 | 708 | 1,021 |
| June | 6,500 | 6,947 | 285,155 | 3,483 | 165,404 | 1,399 | 86,325 | 1,123 | 50,216 | 624 | 999 |
| July | 6,242 | 6,916 | 284,894 | 3,480 | 158,010 | 1,416 | 101,657 | 1,089 | 54,365 | 724 | 1,038 |
| August | 6,168 | 6,862 | 281,043 | 3,492 | 153,168 | 1,453 | 117,579 | 1,069 | 56,322 | 664 | 966 |
| September | 6,151 | 6,939 | 274,608 | 3,511 | 150,916 | 1,514 | 128,061 | 1,086 | 56,702 | 672 | 999 |
| October | 6,135 | 6,834 | 269,442 | 3,457 | 149,661 | 1,545 | 139,128 | 1,066 | 56,541 | 642 | 1,065 |
| November | 6,346 | 6,975 | 264,566 | 3,530 | 150,604 | 1,622 | 133,886 | 1,120 | 54,891 | 636 | 1,104 |
| December | 6,394 | 7,238 | 258,385 | 3,605 | 155,400 | 1,668 | 108,144 | 1,187 | 52,105 | 729 | 1,301 |
| 1955: | | | | | | | | | | | |
| January | 6,761 | 7,379 | 260,156 | 3,639 | 169,562 | 1,740 | 86,692 | 1,235 | 49,457 | 739 | 1,348 |
| February | 6,835 | 7,549 | 258,630 | 3,655 | 181,643 | 1,847 | 68,513 | 1,239 | 46,042 | 751 | 1,379 |
| March | 6,886 | 7,374 | 264,430 | 3,543 | 183,972 | 1,703 | 62,457 | 1,185 | 44,970 | 742 | 1,319 |
| April | 6,887 | 7,136 | 275,232 | 3,502 | 175,601 | 1,534 | 70,139 | 1,110 | 43,838 | 697 | 1,123 |
| May | 6,677 | 7,281 | 276,948 | 3,605 | 168,751 | 1,519 | 83,559 | 1,111 | 45,083 | 742 | 1,137 |
| June | 6,613 | 7,484 | 270,850 | 3,725 | 157,439 | 1,628 | 100,652 | 1,080 | 44,398 | 764 | 1,159 |
| July | 6,632 | 7,580 | 264,601 | 3,824 | 157,079 | 1,575 | 119,169 | 1,091 | 44,894 | 860 | 1,161 |
| August | 6,665 | 7,580 | 256,427 | 3,858 | 151,912 | 1,621 | 133,675 | 1,090 | 45,480 | 756 | 1,155 |
| September | 6,731 | 7,483 | 256,269 | 3,784 | 150,194 | 1,621 | 143,248 | 1,061 | 46,267 | 829 | 1,218 |
| October | 6,732 | 7,393 | 257,277 | 3,723 | 151,777 | 1,563 | 151,747 | 1,108 | 46,142 | 820 | 1,169 |
| November | 6,831 | 7,663 | 257,713 | 3,756 | 156,949 | 1,682 | 141,609 | 1,138 | 44,410 | 829 | 1,266 |
| Nov. 1955 Change: | | | | | | | | | | | |
| In Month | +99 | +270 | +436 | +33 | +5,172 | +119 | −10,138 | +30 | −1,732 | +9 | +97 |
| In Year | +485 | +688 | −6,853 | +226 | +6,345 | +60 | +7,723 | +18 | −10,481 | +193 | +162 |
| Week Ended: | | | | | | | | | | | |
| 12–9–55 | 6,923 | 7,618 | 256,920 | 3,792 | 158,374 | 1,695 | 134,413 | 1,217 | 42,767 | 957 | 1,467 |
| 12–10–54 | 6,341 | 7,105 | 265,373 | 3,513 | 150,653 | 1,540 | 124,067 | 1,126 | 52,803 | 676 | 1,097 |

Source: Data for last two months from API; prior monthly data from Bureau of Mines.



## U. S. Wells Completed in November and First Eleven Months, 1955-1954

| STATE or DISTRICT | NEW WELLS COMPLETED AND FOOTAGE DRILLED — DETAILS FOR NOVEMBER: Oil | Dist. | Gas | Dry | Water Input | Gas Input | Water Disposal | TOTAL NEW WELLS: Nov., 1955 | Oct., 1955 | Nov., 1954 | Total Footage Nov., 1955 | DETAILS FOR JANUARY-NOVEMBER — NEW WELLS: 1955 | 1954 | Percent Diff. | FOOTAGE: 1955 | 1954 | Rigs in Operation: Nov. 30, 1955 | Oct. 31, 1955 | Nov. 30, 1954 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 1 | | | 3 | | | | 4 | 1 | 5 | 28,567 | 40 | 67 | — 40.3 | 185,962 | 348,444 | 8 | 9 | 5 |
| Arizona | 1 | | | | | | | 1 | | 1 | 6,382 | 5 | 9 | — 44.5 | 22,518 | 37,264 | | | 1 |
| Arkansas | 51 | | | 35 | | | | 86 | 74 | 43 | 253,223 | 736 | 533 | + 38.1 | 2,381,272 | 1,878,764 | 52 | 65 | 34 |
| California | 134 | | 10 | 59 | 1 | | | 204 | 218 | 226 | 977,578 | 2,198 | 2,221 | — 1.0 | 10,817,836 | 10,144,534 | 225 | 239 | 250 |
| Colorado | 32 | | 14 | 72 | | | | 118 | 147 | 116 | 612,888 | 1,400 | 1,190 | + 17.6 | 7,490,226 | 6,546,272 | 96 | 108 | 78 |
| Florida | | | | 1 | | | | 1 | | 1 | 12,631 | 25 | 28 | — 10.7 | 234,467 | 177,631 | 1 | 2 | 2 |
| Georgia | | | | 1 | | | | 1 | | | 5,175 | 2 | 8 | — 75.0 | 9,305 | 20,508 | 2 | 2 | |
| Idaho | | | | | | | | | | | | 3 | | | 11,337 | | | | 1 |
| Illinois | 169 | | 4 | 125 | 1 | | 2 | 301 | 378 | 290 | 861,600 | 3,487 | 2,928 | + 19.1 | 8,529,436 | 7,121,147 | 311 | 318 | 325 |
| Indiana | 24 | | | 27 | | | | 51 | 46 | 73 | 89,564 | 566 | 788 | — 28.2 | 889,556 | 1,199,818 | 101 | 91 | 120 |
| Kansas | 187 | | 51 | 162 | | | | 400 | 393 | 317 | 1,375,286 | 4,255 | 3,801 | + 11.9 | 16,092,542 | 13,483,039 | 490 | 480 | 490 |
| Kentucky | 80 | | 17 | 79 | | | | 176 | 171 | 129 | 217,218 | 1,552 | 1,273 | + 21.9 | 2,303,381 | 2,397,952 | 138 | 126 | 90 |
| Louisiana | 197 | 9 | 33 | 99 | | | | 338 | 357 | 341 | 2,394,416 | 3,782 | 3,322 | + 13.8 | 24,617,764 | 20,614,053 | 398 | 378 | 314 |
| North Louisiana | 96 | | 20 | 48 | | | | 164 | 209 | 192 | 601,280 | 1,945 | 1,770 | + 9.9 | 6,151,426 | 5,258,348 | 78 | 86 | 58 |
| South Louisiana | 101 | 9 | 13 | 51 | | | | 174 | 148 | 149 | 1,793,136 | 1,837 | 1,552 | + 18.4 | 18,466,338 | 15,355,705 | 320 | 292 | 256 |
| * Gulf of Mexico | 27 | 1 | | 12 | | | | 40 | 30 | 25 | 589,827 | 317 | 217 | + 46.1 | 3,175,372 | 1,992,343 | 52 | 50 | 31 |
| Maryland | | | | | | | | | | | | | | | | | 2 | 2 | 3 |
| Michigan | 17 | | 4 | 13 | | | | 34 | 51 | 43 | 101,290 | 477 | 508 | — 6.1 | 1,418,459 | 1,389,306 | 87 | 85 | 103 |
| Mississippi | 12 | | 1 | 32 | | | | 45 | 39 | 43 | 330,041 | 424 | 395 | + 7.3 | 3,089,643 | 2,789,041 | 35 | 40 | 47 |
| Missouri | | | | | | | | | | | | 24 | 11 | +118.2 | 13,095 | 11,798 | 3 | 3 | 3 |
| Montana | 22 | | 1 | 24 | | | | 47 | 37 | 33 | 203,889 | 339 | 314 | + 71.6 | 1,642,812 | 1,270,472 | 55 | 50 | 43 |
| Nebraska | 24 | | | 46 | | | | 70 | 89 | 41 | 381,528 | 779 | 408 | + 90.9 | 4,468,843 | 2,280,550 | 42 | 57 | 37 |
| Nevada | | | | | | | | | | | | 6 | 11 | — 45.5 | 44,828 | 56,156 | 3 | 1 | 4 |
| New Mexico | 74 | | 48 | 33 | | | | 155 | 165 | 81 | 696,657 | 1,588 | 1,066 | + 49.0 | 6,807,664 | 5,622,123 | 168 | 157 | 105 |
| New York | 20 | | 1 | | 13 | | | 34 | 37 | 21 | 48,879 | 331 | 493 | — 31.7 | 466,936 | 716,664 | 53 | 51 | 45 |
| North Dakota | 13 | | | 7 | | | | 20 | 28 | 23 | 149,365 | 237 | 261 | — 9.2 | 1,673,527 | 1,829,583 | 27 | 22 | 25 |
| Ohio | 50 | | 19 | 36 | | | | 105 | 113 | 85 | 216,619 | 1,097 | 978 | + 12.2 | 2,283,798 | 1,958,903 | 215 | 218 | 192 |
| Oklahoma | 395 | | 21 | 197 | 4 | | 5 | 622 | 690 | 558 | 2,193,881 | 7,022 | 7,163 | — 2.0 | 24,325,941 | 24,422,759 | 685 | 669 | 672 |
| Oregon | | | | | | | | | | | | | | | | | | | 1 |
| Pennsylvania | 15 | | 22 | 5 | 11 | 5 | | 58 | 64 | 62 | 108,229 | 672 | 871 | — 22.9 | 1,273,598 | 1,606,871 | 122 | 132 | 127 |
| South Dakota | | | | | | | | | 3 | 2 | | 12 | 19 | — 36.9 | 52,476 | 98,629 | 2 | 1 | 1 |
| Texas | 1,032 | 25 | 62 | 635 | 10 | | | 1,764 | 1,685 | 1,499 | 7,401,376 | 18,020 | 16,723 | + 7.8 | 78,881,531 | 74,719,355 | 1,510 | 1,457 | 1,302 |
| Dist. 1: South Central | 99 | | 2 | 61 | | | | 162 | 179 | 116 | 450,770 | 1,646 | 1,044 | + 57.7 | 4,378,265 | 3,427,059 | 50 | 61 | 40 |
| Dist. 2: Middle Gulf | 20 | 3 | 12 | 49 | | | | 84 | 75 | 69 | 550,766 | 760 | 752 | + 1.1 | 4,592,412 | 4,607,888 | 41 | 45 | 31 |
| Dist. 3: Upper Gulf | 50 | 12 | 13 | 56 | | | | 131 | 166 | 144 | 812,858 | 1,625 | 1,597 | + 1.8 | 10,436,763 | 10,641,145 | 141 | 145 | 127 |
| * Gulf of Mexico | | 1 | | | | | | 1 | 3 | | 11,489 | 14 | | | 138,881 | | 3 | 3 | 3 |
| Dist. 4: Lower Gulf-S.W. | 34 | 10 | 2 | 50 | 2 | | | 98 | 107 | 104 | 529,580 | 1,222 | 1,304 | — 6.3 | 6,474,190 | 6,818,992 | 83 | 94 | 75 |
| * Gulf of Mexico | | | | | | | | | | 1 | | 12 | 3 | +300.0 | 115,549 | 34,281 | 3 | 3 | 2 |
| Dist. 5: East Central | 5 | | 3 | 14 | | | | 22 | 20 | 32 | 80,726 | 217 | 259 | — 16.2 | 846,620 | 1,013,622 | 11 | 14 | 20 |
| Dist. 6: Northeast | 32 | | 13 | 39 | | | | 84 | 63 | 69 | 445,156 | 683 | 674 | + 1.3 | 3,638,139 | 3,921,468 | 71 | 64 | 61 |
| Dist. 7-B: North Central | 149 | | 8 | 131 | | | | 288 | 264 | 254 | 980,869 | 2,861 | 2,704 | + 5.8 | 9,292,416 | 8,590,529 | 168 | 162 | 142 |
| Dist. 7-C: West Central | 53 | | 3 | 41 | | | | 97 | 91 | 98 | 453,552 | 1,075 | 1,178 | — 8.8 | 5,749,247 | 6,160,630 | 135 | 110 | 127 |
| Dist. 8: West | 300 | | 2 | 53 | 7 | | | 362 | 360 | 215 | 1,754,081 | 3,568 | 2,599 | + 37.3 | 19,211,073 | 15,370,340 | 455 | 420 | 356 |
| Dist. 9: North | 225 | | | 137 | 1 | | | 363 | 285 | 337 | 1,094,282 | 3,464 | 3,740 | — 7.4 | 11,106,956 | 11,267,745 | 255 | 249 | 252 |
| Dist. 10: Panhandle | 65 | | 4 | 4 | | | | 73 | 75 | 61 | 248,628 | 888 | 872 | + 1.8 | 3,134,845 | 2,899,937 | 100 | 93 | 71 |
| Utah | | | 2 | 4 | | | | 6 | 2 | 7 | 19,894 | 87 | 63 | + 38.1 | 382,965 | 277,515 | 33 | 29 | 22 |
| Washington | | | | | | | | | | | | | 1 | | | 3,737 | | | 1 |
| West Virginia | 4 | | 32 | 16 | | | | 52 | 61 | 45 | 133,867 | 590 | 513 | + 15.0 | 1,561,146 | 1,482,513 | 181 | 198 | 163 |
| Wyoming | 27 | | 5 | 33 | | | | 65 | 129 | 83 | 334,878 | 737 | 1,058 | — 30.4 | 3,645,374 | 5,600,838 | 115 | 134 | 79 |
| Total United States | 2,581 | 34 | 347 | 1,744 | 40 | 5 | 7 | 4,758 | 4,978 | 4,168 | 19,154,921 | 50,511 | 47,027 | + 7.4 | 205,625,539 | 190,106,239 | 5,160 | 5,124 | 4,685 |
| Total Western Canada | 206 | | 5 | 68 | | | | 279 | 151 | 225 | 1,265,371 | 2,412 | 1,969 | + 22.5 | 10,427,626 | 7,735,123 | 228 | 219 | 189 |

* Gulf of Mexico wells are included in their respective district totals.

# New Drilling Mark Assured

### 50,511 wells in 11 months lead by 7.4%

DRILLING RATES during November were down only slightly from October's record-breaking activity, and as a result the year's 11-months total of wells drilled was boosted into a 7.4 percent lead over last year's record. The 1955 operations are now only a short step behind the 1954 over-all, and a new annual drilling mark is now certain.

November's new wells numbered 4758, which was under the 4979 recorded in October for the greatest monthly total in history. However, the month's tests topped, by a substantial margin, the 4169 wells completed in November, 1954. Due to the difference in the number of days in October and November, a wells-per-day comparison shows that the latter month's daily average was only two less than October's record average.

At the end of 11 months, records show that a total of 50,511 new wells had been drilled in the U. S. this year. Not yet overtaking the 1954 annual total, but so close that by the end of the second week in December a new all-time U. S. drilling peak will have been reached. WORLD OIL taking a new look at the nation's drilling at mid-year (August 15, 1955) forecast a total of 55,267 new wells for the year. That should prove to be very close to the final count, and it would be almost on the nose if December duplicates the previous month's efforts.

An even greater indication of this year's drilling effort is a comparison of the amount of footage drilled against last year's. In 11 months, a total of 205,625,539 feet was recorded, and that amounted to an increase of 8.2 percent over the 190,106,239 feet drilled in the comparable period of 1954. This year's wells have been slightly deeper, having been drilled to 4071 feet on the average while last year's were taken to 4042 feet.

The number of active drilling rigs has been steadily climbing for the past several months, and at the end of November they totaled 5160. That was an increase of 36 during the month, and the greatest concentration of active tools since the end of 1951.

# SEVEN CAT* OILFIELD ENGINES POWER DIXIE'S NEW OFFSHORE RIG



*These three D397 Engines power the drawworks for Dixie's offshore rig at Terrebonne Bay.*

When Dixie Drilling Co., Houston, Tex., equipped its new offshore rig, it specified seven modern, heavy-duty Caterpillar Oilfield Engines for power. They include three D397s on the drawworks, a D364 on the mud pump, a D337 on the coring line and two D318 Electric Sets.

These four-cycle oilfield engines are ready to work 24 hours a day for years—there are some with over 100,000 hours on their meters! They offer the dependability so necessary in an offshore operation.

And by standardizing on Cat Oilfield Engines, operators and mechanics are familiar with one make of machinery, so they do their jobs faster and easier. Too, parts inventory can be kept low since many parts on these engines are interchangeable.

But more than that, Dixie took advantage of Caterpillar flexibility. There is a wide choice of attachments, giving power tailored to your own special needs. You enjoy a choice of torque converter drive, fluid couplings, or direct drive arranged in the way which helps you do your job best. Air controls and air clutches give you swift, smooth, flexible operation.

And there has been a continual parade of engine and electric set improvements coming from Caterpillar. For instance, the new D337 (Series F) has been turbocharged to produce 310 HP maximum at 2000 RPM. All Cat Engines are offered with a choice of three starting systems—air, electric and gasoline. And there are many other recent advances in this and other Caterpillar Oilfield Engines.

Now is the time to stop in and see your nearby Caterpillar Dealer. He has a full line of new engines and electric sets all designed to save you money, time and trouble.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

**CATERPILLAR***

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

**MODERN HEAVY-DUTY OILFIELD ENGINES**

## Wildcat Drilling—in November and First Eleven Months, 1955-1954

| STATE or DISTRICT | MONTH OF NOVEMBER, 1955 | | | | | | FIRST ELEVEN MONTHS, 1955-1954 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | New Fields | | | Total Discoveries | Dry Wildcats | Total Wildcat Tests | New Fields | | | Total Discoveries | | Dry Wildcats | | Total Wildcat Tests | |
| | Oil | Distillate | Gas | | | | Oil | Distillate | Gas | 11 Mo. 1955 | 11 Mo. 1954 | 11 Mo. 1955 | 11 Mo. 1954 | 11 Mo. 1955 | 11 Mo. 1954 |
| Alabama | 1 | .. | .. | .. | 3 | 3 | .... | .... | .... | .... | .... | 37 | 58 | 37 | 58 |
| Arizona | .. | .. | .. | 1 | .. | 1 | 1 | .... | .... | 1 | 1 | 4 | 8 | 5 | 9 |
| Arkansas | .. | .. | .. | .. | 15 | 15 | 9 | .... | 2 | 11 | 4 | 129 | 95 | 140 | 99 |
| California | .. | .. | 2 | 2 | 38 | 40 | 16 | .... | 6 | 22 | 28 | 313 | 317 | 335 | 345 |
| Colorado | 6 | .. | 3 | 9 | 51 | 60 | 39 | 1 | 22 | 62 | 63 | 677 | 508 | 739 | 571 |
| Florida | .. | .. | .. | .. | 1 | 1 | .... | .... | .... | .... | 1 | 24 | 25 | 24 | 26 |
| Georgia | .. | .. | .. | .. | 1 | 1 | .... | .... | .... | .... | .... | 2 | 8 | 2 | 8 |
| Idaho | .. | .. | .. | .. | .. | .. | .... | .... | 1 | 1 | .... | 2 | 1 | 3 | 1 |
| Illinois | 3 | .. | .. | 3 | 56 | 59 | 25 | .... | 3 | 28 | 24 | 646 | 545 | 674 | 569 |
| Indiana | .. | .. | .. | .. | 9 | 9 | 9 | .... | 1 | 10 | 11 | 159 | 248 | 169 | 259 |
| Kansas | 7 | .. | 2 | 9 | 90 | 99 | 137 | .... | 33 | 170 | 133 | 894 | 676 | 1,064 | 809 |
| Kentucky | .. | .. | .. | .. | 9 | 9 | 13 | .... | 2 | 15 | 22 | 88 | 51 | 103 | 73 |
| Louisiana | 8 | 2 | 1 | 11 | 37 | 48 | 39 | 24 | 6 | 69 | 69 | 446 | 360 | 515 | 429 |
| North Louisiana | .. | .. | .. | .. | 22 | 22 | 6 | 3 | 2 | 11 | 10 | 185 | 155 | 196 | 165 |
| South Louisiana | 8 | 2 | 1 | 11 | 15 | 26 | 33 | 21 | 4 | 58 | 59 | 261 | 205 | 319 | 264 |
| Michigan | 2 | .. | .. | 2 | 7 | 9 | 5 | .... | 1 | 6 | 11 | 175 | 195 | 181 | 206 |
| Mississippi | .. | .. | .. | .. | 24 | 24 | 7 | 1 | .... | 8 | 6 | 167 | 155 | 175 | 161 |
| Missouri | .. | .. | .. | .. | .. | .. | .... | .... | .... | .... | .... | 17 | 6 | 17 | 6 |
| Montana | 2 | .. | 1 | 3 | 15 | 18 | 10 | 2 | 1 | 13 | 9 | 129 | 94 | 142 | 103 |
| Nebraska | 5 | .. | .. | 5 | 35 | 40 | 38 | .... | 1 | 39 | 32 | 314 | 131 | 353 | 163 |
| Nevada | .. | .. | .. | .. | .. | .. | .... | .... | .... | .... | 1 | 4 | 10 | 4 | 11 |
| New Mexico | 6 | .. | 1 | 7 | 19 | 26 | 29 | 2 | 28 | 59 | 57 | 136 | 148 | 195 | 205 |
| New York | .. | .. | 1 | 1 | .. | 1 | .... | .... | 1 | 1 | .... | .... | .... | 1 | .... |
| North Dakota | 1 | .. | .. | 1 | 4 | 5 | 5 | .... | .... | 5 | 2 | 59 | 101 | 64 | 103 |
| Ohio | .. | .. | .. | .. | .. | .. | .... | .... | 1 | 1 | .... | 15 | 12 | 16 | 12 |
| Oklahoma | 9 | .. | 1 | 10 | 50 | 60 | 93 | 11 | 19 | 123 | 128 | 589 | 643 | 712 | 771 |
| Oregon | .. | .. | .. | .. | .. | .. | .... | .... | .... | .... | .... | 1 | .... | 1 | .... |
| Pennsylavnia | .. | .. | .. | .. | .. | .. | .... | .... | 1 | 1 | .... | 2 | 1 | 3 | 1 |
| South Dakota | .. | .. | .. | .. | .. | .. | .... | .... | .... | .... | 1 | 12 | 13 | 12 | 14 |
| Texas | 41 | 6 | 13 | 60 | 379 | 439 | 497 | 75 | 65 | 637 | 642 | 3,794 | 3,780 | 4,431 | 4,422 |
| Dist. 1: South Central | 2 | .. | 1 | 3 | 37 | 41 | 22 | 4 | 2 | 28 | 32 | 376 | 296 | 404 | 328 |
| Dist. 2: Middle Gulf | .. | .. | 5 | 5 | 40 | 45 | 17 | 19 | 8 | 44 | 31 | 247 | 247 | 291 | 278 |
| Dist. 3: Upper Gulf | .. | 4 | 1 | 5 | 26 | 31 | 16 | 24 | 8 | 48 | 39 | 375 | 369 | 423 | 408 |
| Dist. 4: Lower Gulf-S.W. | 2 | 2 | .. | 5 | 33 | 38 | 30 | 19 | 8 | 57 | 51 | 364 | 338 | 421 | 389 |
| Dist. 5: East Central | .. | .. | .. | .. | 8 | 8 | 3 | 3 | .... | 6 | 3 | 123 | 135 | 129 | 138 |
| Dist. 6: Northeast | 1 | .. | .. | 1 | 22 | 23 | 4 | 3 | .... | 7 | 8 | 173 | 151 | 180 | 159 |
| Dist. 7-B: North Central | 13 | .. | 3 | 16 | 91 | 107 | 152 | 1 | 13 | 163 | 183 | 831 | 828 | 997 | 1,011 |
| Dist. 7-C: West Central | 6 | .. | 2 | 8 | 28 | 36 | 44 | .... | 9 | 53 | 60 | 250 | 325 | 303 | 385 |
| Dist. 8: West | 9 | .. | 1 | 10 | 29 | 39 | 77 | .... | 2 | 79 | 95 | 394 | 331 | 473 | 426 |
| Dist. 9: North | 6 | .. | .. | 6 | 63 | 69 | 129 | 2 | 8 | 139 | 124 | 599 | 707 | 738 | 831 |
| Dist. 10: Panhandle | 1 | .. | .. | 1 | 2 | 3 | 3 | 5 | 2 | 10 | 16 | 42 | 53 | 52 | 69 |
| Utah | .. | .. | 2 | 2 | 4 | 6 | 7 | .... | 7 | 14 | 5 | 64 | 39 | 78 | 44 |
| Washington | .. | .. | .. | .. | .. | .. | .... | .... | .... | .... | .... | .... | 1 | .... | 1 |
| West Virginia | .. | .. | .. | .. | .. | .. | .... | .... | 8 | 8 | .... | 13 | 2 | 21 | 2 |
| Wyoming | 2 | .. | .. | 2 | 17 | 19 | 22 | .... | 3 | 25 | 64 | 178 | 194 | 203 | 258 |
| Total United States | 93 | 8 | 27 | 128 | 864 | 992 | 1,001 | 116 | 212 | 1,329 | 1,314 | 9,090 | 8,425 | 10,419 | 9,739 |

# Wildcatting Record Near

## Most active year holds onto 7 percent lead.

THE GREATEST wildcatting year in history is fast coming to a close. At least, it has seen the greatest numbers of tests drilled. Whether it proves the most prolific in yielding oil and gas supplies remains for the reserves calculators to show.

**Summary of Results of Wildcat Drilling**

| ITEM | Nov., 1955 | Oct., 1955 | ELEVEN MONTHS January-November 1955 | 1954 | Percent Diff. |
|---|---|---|---|---|---|
| New Field Discoveries: | | | | | |
| Oil | 93 | 77 | 1,001 | 981 | + 2.0 |
| Distillate | 8 | 14 | 116 | 109 | + 6.4 |
| Gas | 27 | 15 | 212 | 224 | — 5.4 |
| Total Discoveries | 128 | 106 | 1,329 | 1,314 | + 1.1 |
| Dry Wildcats | 864 | 922 | 9,090 | 8,425 | + 7.9 |
| Total Wildcat Tests | 992 | 1,028 | 10,419 | 9,739 | + 7.0 |
| Percent Productive | 12.9 | 10.3 | 12.8 | 13.5 | ..... |
| Percent Dry | 87. | 89.7 | 87.2 | 86.5 | ..... |

Regardless, it takes wildcat wells in great numbers to keep future supplies for an oil and gas hungry nation assured. And it was in this area that the nation's wildcatters have done an exceptionally good job. Last year had been the most active exploratory year in history, but 1955 has far surpassed it in activity, and at the end of 11 months 1955 leads with 7 percent more wildcat tests.

Despite the substantial increase in total wells, the current year has been pressed to keep ahead of 1954 in discoveries. With one month remaining, 1955's new finds are holding onto a slim 15-discovery lead, while failures have amounted to almost 8 percent more.

A total of 10,419 wildcats have been recorded as complete in 1955, and that figures 7 percent greater than the 9739 drilled during the same period of 1954. However, 1955 discoveries totalling 1329 amounted to only 12.8 percent of the total drilled, while 1954's 1314 pools scored a better 13.5 percent.

Never before has as many as 1000 new oil fields been found in a 11-month period, but industry did it in '55. The last count was 1001, and that was 20 new oil fields, or 2 percent, more than were credited to 1954's similar period.

New gas-distillate fields also have shown some increase, being 116 against 109 a year ago. Natural gas discoveries were the only ones to record a decline. So far, they have numbered 212 to 1954's 224.

Unfortunately, the greatest increase in 1955 has been among the failures. In 11 months, 9090 wildcats were plugged as unsuccessful, and that was 7.9 percent more than the 8425 that missed the mark a year earlier.

# Take a Look at Montana's Genou Trend

**• This 35-mile long trend in north central Montana is a pre-Cambrian basement structural alignment on which are located a number of structural highs.**

**• Almost all of the Paleozoic section was cored in three test wells drilled by General Petroleum Corporation.**

**By ANDREW G. ALPHA,** Signal Oil and Gas Company, Denver

THE GENOU TREND is a pre-Cambrian basement structural alignment on which are located a number of structural highs. It is 35 miles long, located in north central Montana and crosses the South Arch of the Sweetgrass Arch, in a northeast direction, south of Collins, towards the center of T28N, R4E. The geological, geophysical and drilling effort which revealed this structural feature was done by General Petroleum Corporation of California.

The exploration effort which discovered this structure, was in search of oil traps similar to those in the Madison limestone fields in the area, and in the Devonian fields in Alberta, Canada. The understanding of the Genou Trend came as a result of integration and coordination of geological and geophysical data.

**Location.** The broad view of the present structural framework of north central Montana shows primarily the Laramide influence. The structure contour map of the Montana Plains, (C. E. Dobbin and C. E. Erdmann, 1946—Figure 1), shows the Sweetgrass Arch to be made up of two structural components, the South Arch and, an echelon to it, the Kevin-Sunburst Dome. The South Arch is an anticlinal nose plunging from the Little Belt Mountains, and terminating at the Pendroy fault. The Marias River syncline separates the South Arch from the Kevin-Sunburst Dome.

The Sweetgrass Arch is flanked on the west by the front ranges of the northern Rocky Mountains, the eastern portion of which is occupied by the Sawtooth range and a squeezed zone, the Disturbed Belt. Several mountains composed of extrusive and intrusive material of late Tertiary age border the area. The Birdtail range on the south consists of volcanic agglomerates, intrusives, extrusives and dikes. The Highwoods to the southeast and the Bearpaw mountains to the northeast are composed of similar rocks. The Sweetgrass hills on the east flank of the Kevin-Sunburst Dome are igneous piercements.

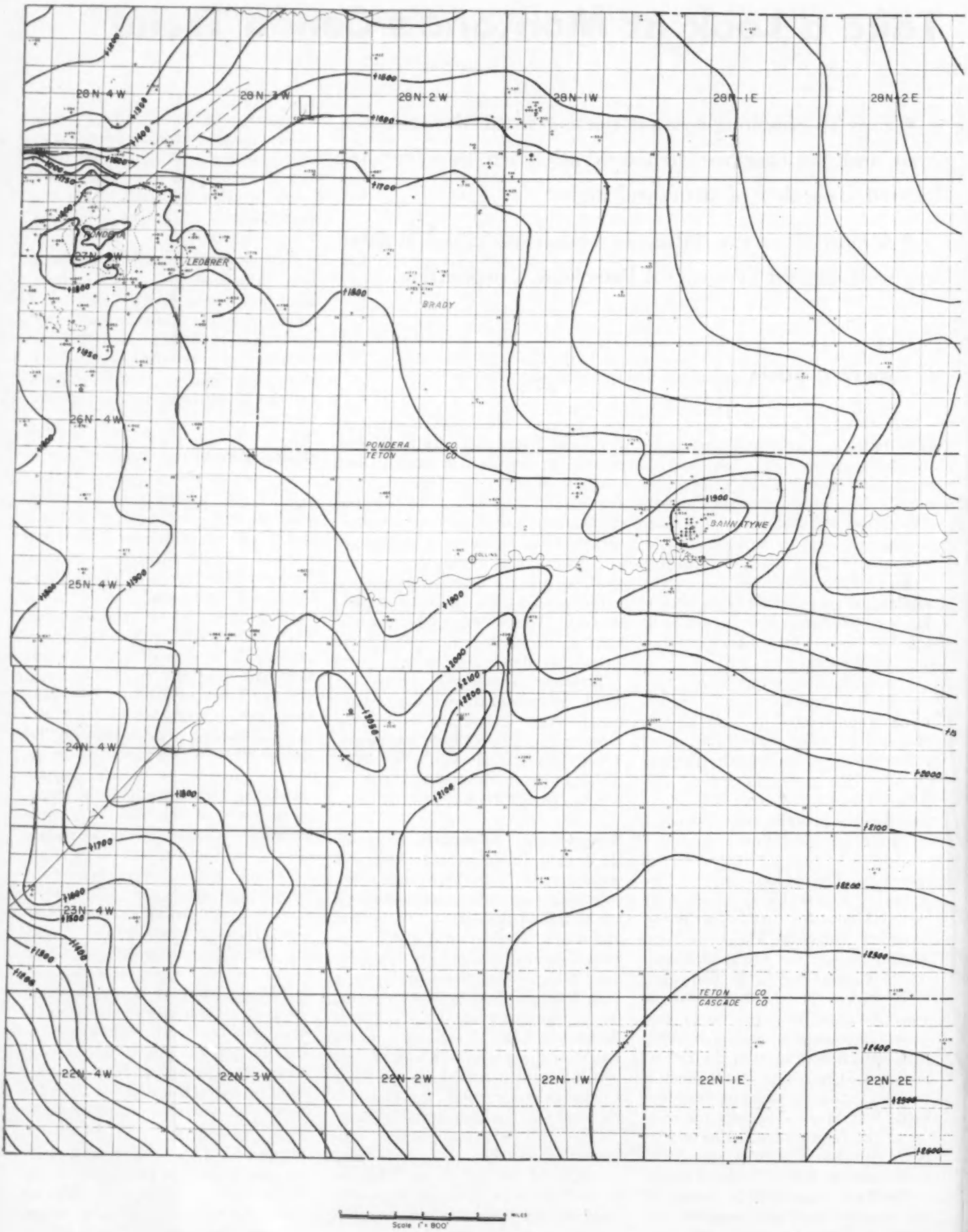
Trending northeast, across the South Arch from the vicinity of Collins through Bannatyne toward the center of T28N, R4E, is the Genou Trend, named after the old postoffice of Genou in the southwest corner of Section 18, T26N, R4E.

**Exploratory Approach.** Initially, the Genou Trend structural element was suspected from the series of structure maps contoured on the base of the Colorado shale by C. E. Dobbin and C. E. Erdmann (1930, 1932, 1946). Figure 1—The Structure Contour Map of the Montana Plains is their 1946 map which shows a nosing to the northeast of the abandoned Bannatyne field. A reentrant in the Eagle escarpment in T28N, R5E, and which is now occupied by the Basin Coulee drainage, might be related to this feature (Dobbin and Erdmann, 1930). This lead was further confirmed by making a structure map contoured on top of the Madison eroded surface. General Petroleum explored this lead by a gravity meter survey which showed a definite trend. This trend was further explored by seismograph which indicated a strong structural axis extending for 35 miles with local highs. Pinchout and thinning of section was postulated and a basement ridge suspected due to the disappearance of deeper reflections toward the trend.

Following seismic work, three tests were drilled on the Trend. These, along with two drilled by other companies definitely established an igneous ridge, at depths from 3300 to 4200 feet, on which there were several highs over which all Cambrian beds and the Lower Devonian section were missing.

**Genou Trend.** The Genou Trend is a segment of the Scapegoat-Bannatyne Trend, a structural alignment which is designated by C. E. Dobbin and C. E. Erdmann on their 1954 revision of the Structure Contour Map of the Montana Plains. The Scapegoat-Bannatyne Trend is a northeast trend of structural anomalies which begins with a transverse fault or fault zone that is the south termination of the Sawtooth range and the Lewis overthrust. This fault zone strikes northeast towards Augusta, Montana and aligns with the Genou Trend.[1] This northeast-southwest orientation of the Scapegoat-Bannatyne Trend parallels the structural grain of the pre- and early Paleozoic features of the Canadian shield in Canada and Minnesota. (Tectonic Map of Canada—1950.) Geophysical evidence points to a similar orientation of the pre-Paleozoic structural fabric in the subsurface through central Montana and North Dakota. Some other features in Montana have a northeast structural orientation such as the Bearpaw Arch, Weldon Fault, Fromberg Fault and the general axis of the Boulder Batholith. This northeast trending grain probably has afforded relief for diastrophic stress at various times since it originated.

Based on data secured from drilling and geophysics, the Genou Trend is a pre-Cambrian basement ridge on which are a number of higher areas. The abandoned Bannatyne field and the location of the General Petroleum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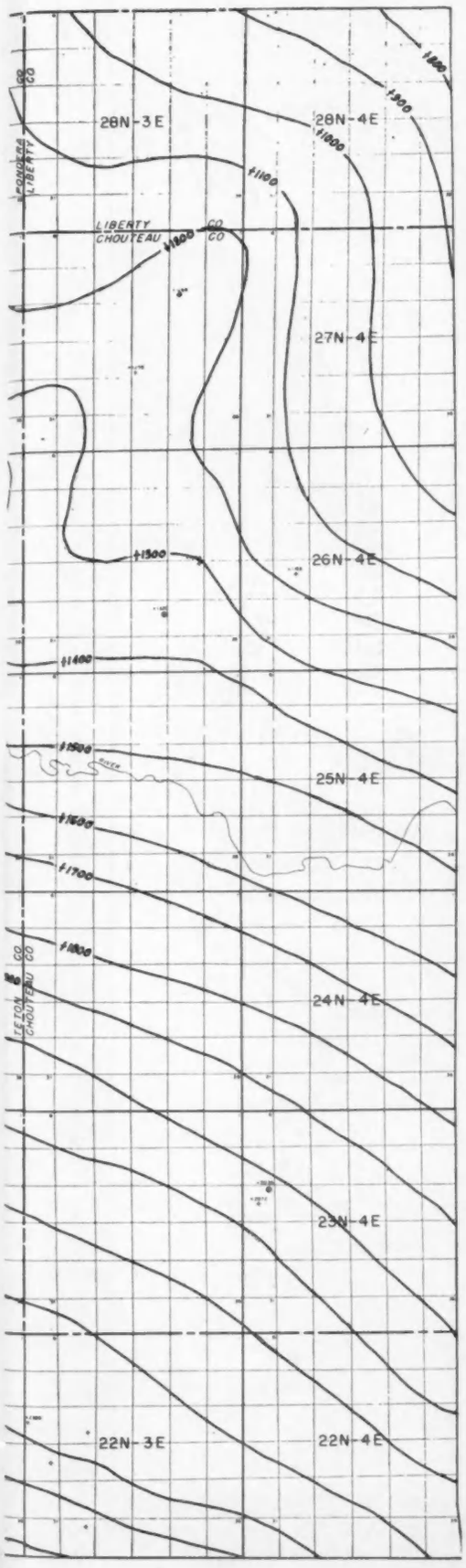



**FIGURE 1—Genou trend-structure interpretation of the eroded surface of Mississippi limestone in Teton-Pondera and Chouteau counties, Montana. Andrew G. Alpha, November, 1954. Contour interval 100 feet.**

Waters 1, Section 12, T24N, R2W, on a structure called Collins are two of the higher features which have been drilled. As an example of the present structural relief on the trend, igneous rock was encountered in the Carney-Speer 1 Bannatyne (Section 5, T25N, R1E) at an altitude of 490 feet above sea level at minus 609 feet in the General Petroleum-Holt 88-30-P (SE SE SE Section 30, T25N, R1W), a plus 514 in the General Petroleum 8-12-P (Section 12, T24N, R2W, Collins area) and at minus 912 feet in the General Petroleum-Kaun 8-11-P (SW SW SW Section 11, T27N, R3E). There is a difference in the elevation on top of the igneous rock surface between the General Petroleum-Kaun and the General Petroleum-Collins 8-12-P of 1426 feet. This relief diminishes upward being 1232 feet at the base of the Colorado shale. This relief is due to several factors such as the initial structural magnitude of the Trend, probably some accent due to pre-Cambrian topography, periodic rejuvenation; thinning of Cambrian, Devonian, Mississippian and Jurassic beds over the area, although the thinning due to the influence of the South Arch cannot be separated from that influenced by the trend, and to the added structure given that portion of the trend where the South Arch was folded across it in the vicinity of Bannatyne and Collins. Available data indicate only minor faulting which might add to the relief. However, the igneous ridge does align with the transverse and other faulting of major proportions to the southwest.

Cambrian and basal Devonian sediments wedge out against the higher portions of the trend. Younger Devonian beds accumulated in part as reef deposits on the igneous core, by the end of Devonian time completely covered the trend. The data at hand does not suggest draping. Folding of the Upper Devonian and later strata over the trend and the individual highs appears to be due to periodic rejuvenation, probably during pre-Jurassic, late Cretaceous and early Tertiary times.

**Age of Trend.** The Genou Trend can be established as a high during Cambrian and Lower Devonian time from the relationship of the stratigraphy to the basement rocks as revealed by the wells in the area.

**Basement Rock**—Wells on the Genou Trend disclosed the backbone of the feature to be igneous rock (Figure 2). This rock was identified as a trachyandesite porphyry in the General Petroleum wells at Collins, Northeast Collins and Bootlegger. Igneous rock in the Carney-Speer well, of which 185 feet was drilled, has been identified as a finely crystalline diabase.[2] The igneous rock in the British American Swenson was labeled a porphyritic andesite. Because these rocks could be closely related, the final identification of all the igneous rock along the trend should await examination by the same petrographer to ascertain differences or similarities.

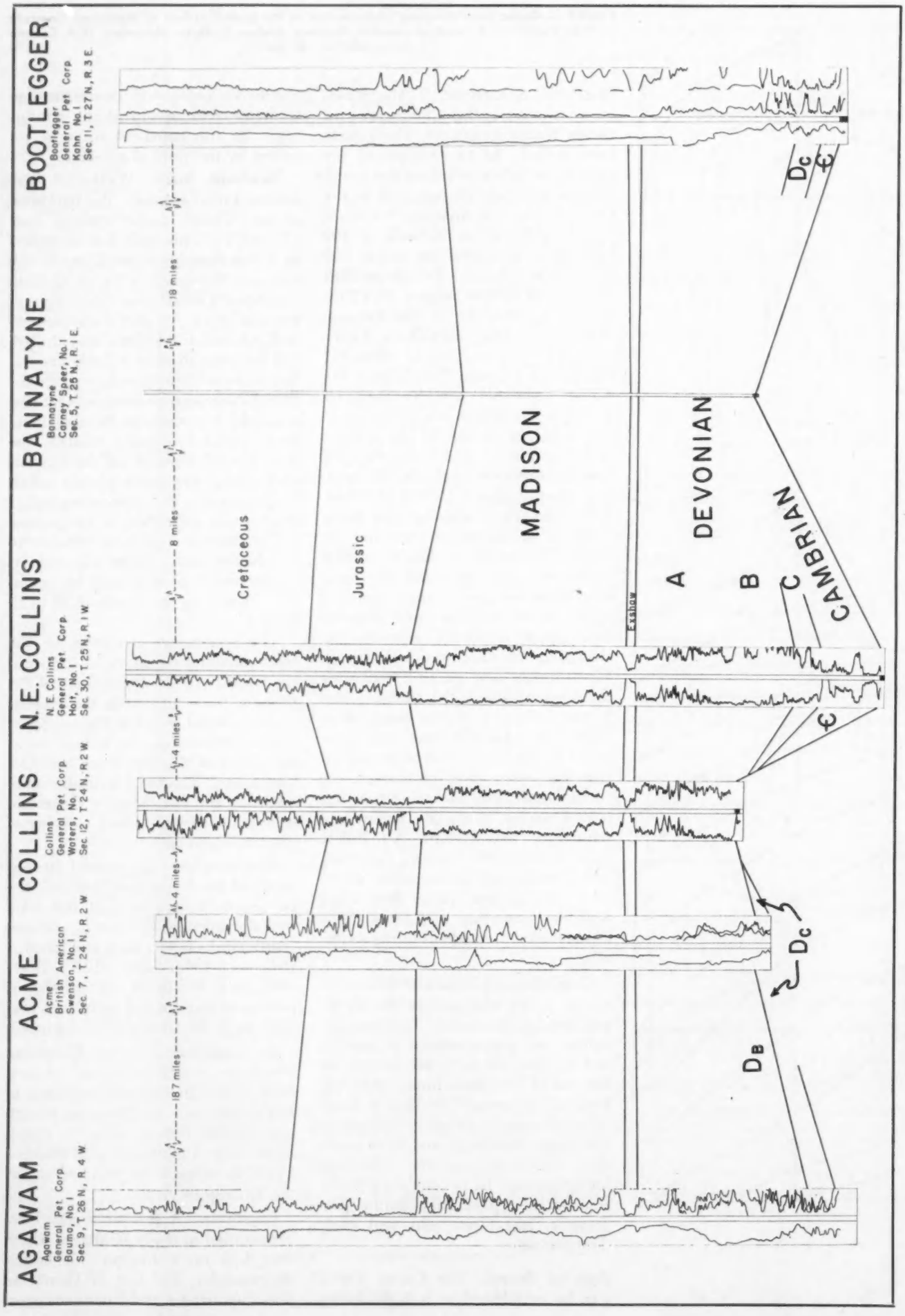
The igneous rock was exposed to weathering and erosion following its emplacement as evidenced by extensive alterations to a depth of 10 to 15 feet.

The weathered character of the trachyandesite porphyry as shown in the cores from the three General Petroleum wells and from the igneous rock recovered from the Carney-Speer well on Bannatyne, the lack of metamorphism of the Cambrian and Devonian beds in contact with this igneous rock and the onlap of Cambrian beds establishes the trend as being of pre-Cambrian age.

**Stratigraphy**—The general stratigraphy of the Sweetgrass Arch will not be reviewed here since it has been well documented by several authors. (Andrichuk—1951, Sloss and Laird—1945 and 1946, Sloss—1950.) However, such details of stratigraphy as pertain to the age and petroleum possibilities of the trend will be discussed.

**Pre-Cambrian**—The pre-Cambrian Belt series, which occurs on the west flank of the Sweetgrass Arch and in an east-trending pre-Devonian trough south of the present arch, the oldest sedimentary rocks in the area (Sloss—1950), have not been found on top of the Sweetgrass Arch.

**Cambrian**—A number of tests have been drilled in the general area which give data on Cambrian thicknesses. As examples, 755 feet of Cambrian shales, quartzites and limestones over-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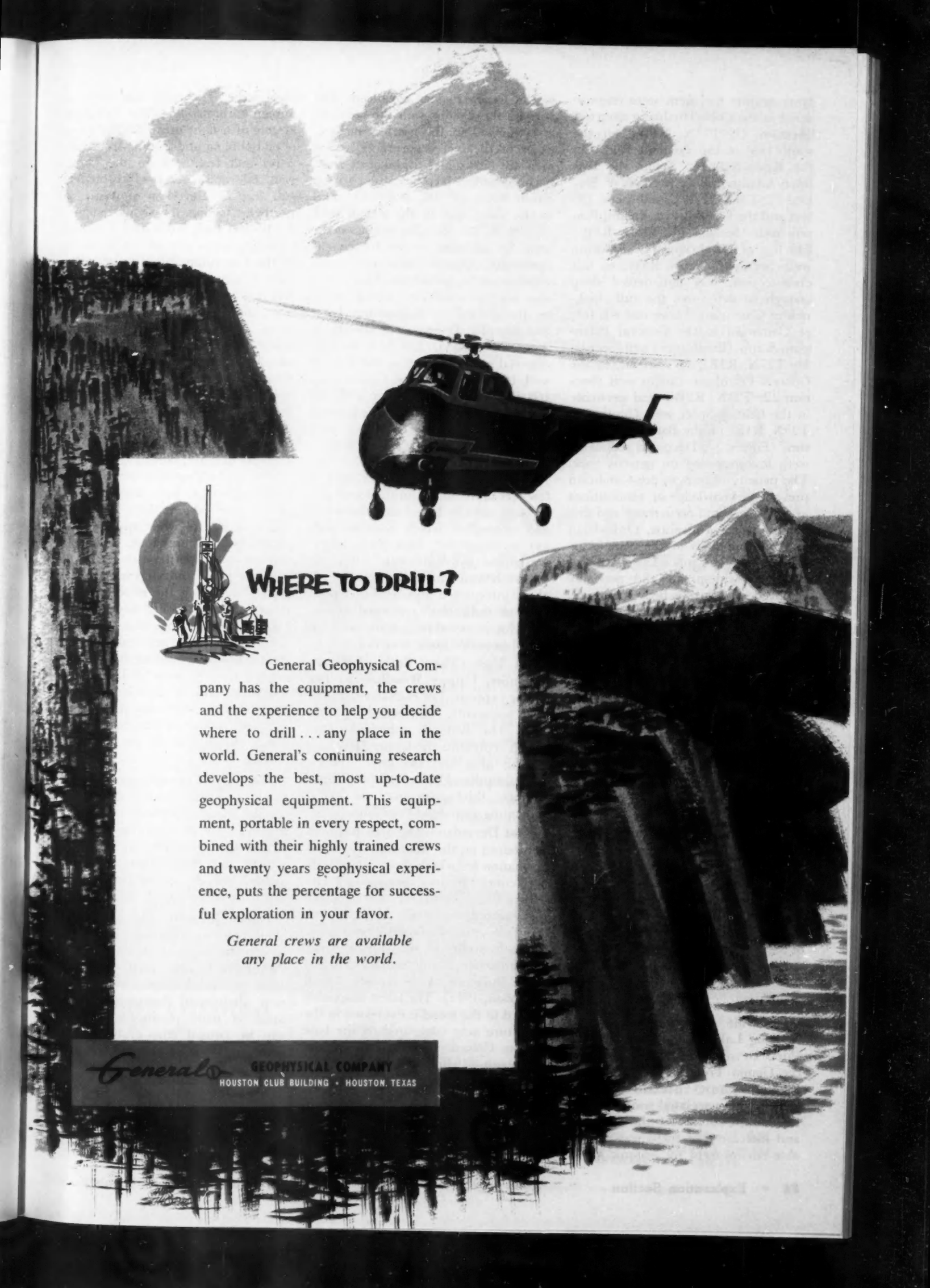

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lying granite basement were encountered in the Cobb-Hirshberg deep test (Section 23, T27N, R4W) on the south side of the Pondera field. On the Kevin-Sunburst Dome the Potlatch-Adams well (NE SE NW Section 21, T34N, R1W) established 730 feet and the Lee Edwards-Inland Empire well (Section 17, T35N, R1W) 845 feet of Cambrian. The Agawam well (Section 9, T26N, R4W) on this cross-section, was not drilled deep enough to determine the full thickness of Cambrian. There was 103 feet of Cambrian in the General Petroleum-Kaun (Bootlegger) well (Section 11, T27N, R3E). In contrast, in the General Petroleum-Collins well (Section 12, T24N, R2W) and probably in the Carney-Speer well (Section 5, T25N, R1E) on the Bannatyne structure (Figure 2), Devonian sediments were found resting on igneous rock. The paucity of tests to pre-Cambrian prevents a knowledge or assumptions as to the original occurrence and distribution of Cambrian, Ordovician and Silurian beds in the Sweetgrass Arch area. Pre- Upper Devonian erosion was widespread and probably removed all Silurian beds if present, all Ordovician and some Cambrian and, on the highs of the trend, some of the pre-Cambrian basement.

**Upper Devonian—Dc Unit (Maywood, Beaverhill Lake)**—The oldest Devonian unit, or Dc, is absent in the General Petroleum-Collins well, but present elsewhere on the trend. The absence of this unit on the higher portion of the Genou Trend and the Sweetgrass Arch suggests that the higher portions of the Sweetgrass Arch were island features during early Upper Devonian time. Coarse conglomerates of limestone and quartzite were found in the British-American Swenson well (Section 7, T24N, R2W) down flank from the trend. These coarse clastics occur in the basal Dc unit, five feet above the top of the Cambrian and can be attributed to the shedding of sediments from highs during the advance of the Devonian sea.

**Db Unit (Jefferson Limestone, Cooking Lake)**—The Db unit is the oldest Devonian member to lie across the Genou Trend. The cores of the Db unit show intermittent reef growth and associated wave debris in the basal 300 feet of the formation and indicate that there was a favorable environment for organic growth as the Devonian seas advanced. The core of the Collins well showed reef growth fixed to the igneous surface. Some of the reef occurrences in the area are biostromal. Biostromes have been identified at the outcrop on Smith River (T13N, R4E) 85 miles to the south and in the Regan field (T37N, R7W) 80 miles to the northwest. In addition to the biostromal limestones, other reef beds were cored which could be biohermal. There were also seismic reflections which could be interpreted as originating from lens deposits. In the wells shown on the cross section, 210 feet of reef material was identified in the Collins well, 180 feet in the East Collins well, 160 feet in the Bootlegger well, 80 feet at Agawam well. In this general area conditions during basal Devonian time were favorable for organic growth.

Individual reef strata vary from a few feet up to 50 feet in thickness and are separated by limestones, dolomites and evaporites which reoccur with cyclic regularity. This phenomenon was noted by Andrichuk (1951) in Saskatchewan and Alberta. Andrichuk interpreted this cyclic deposition as indicating restricted conditions far removed from sources which might provide clastic material.

**Da Unit (Three Forks, Jefferson Dolomite, Upper Woodbend)**—The major expression of the Genou Trend was apparently obliterated by $Da_2$ time. The Potlatch anhydrite—$Da_1$, which represents the Upper Devonian in this area and the later Exshaw (Mississippian-Devonian) show rather uniform thicknesses over the trend indicating near-level conditions.

**Post Devonian**—The area has been contoured on the Madison, the oldest formation for which there is adequate well control to show the Genou Trend (Figure 2). However, the structure as depicted, represents in part post-Madison and Laramide orogenesis. Isopach studies of the Jurassic show the influence of the South Arch and some influence of the Genou Trend (Cobban, 1945). The latest mappable record of the trend is expressed in the structure map contoured on the base of the Colorado shale (Dobbin and Erdmann—1946) (Figure 1). This may represent in part Laramide rejuvenation.

**Petroleum Occurrences**—Devonian—Almost all of the Paleozoic section was cored in the three General Petroleum wells. The cores had shows at numerous horizons in the Devonian, largely of a light green distillate type of oil bubbling and seeping from vugs, pores and fractures. In the Collins well, oil shows occurred throughout 420 feet of Devonian section. At northeast Collins the shows extended for 85 feet and, interestingly enough, including a few feet of the limestones of the Cambrian. Bleeding of oil occurred from porous zones throughout 480 feet in the Bootlegger well; however, these shows were not as prominent as in the other areas. These zones yielded water with only a trace of oil on drill stem tests. The British-American Swenson 1, a flank well, obtained 800 Mcf rate of non-combustible gas on drill stem tests in the middle portion of the Devonian.

Along the trend there is abundant evidence of initial porosity and permeability in the Devonian section in the form of vugs and intercrystalline pores. The present lack of permeability is due to what appears to be almost contemporaneous, cyclic deposition of evaporites which filtered into the pores and vugs almost completely nullifying the effectiveness of what otherwise would have been an extremely permeable rock.

Porosity and permeability were established in several zones in the Devonian in two wells drilled on the southeast flank of the Genou Trend. Some of these zones may provide stratigraphic traps on the flank of the trend at the line of permeability change.

**Madison**—The nearest Madison production, the Pondera field, is primarily stratigraphic (Figure 2). Shows in the Madison on the Genou Trend was generally in the upper weathered portion. These shows have yielded only water on tests, a characteristic of the South Arch area.

**Upper Jurassic**—The swift sandstone was saturated with a heavy tar in all the wells drilled by General Petroleum on the trend. This sandstone produced 23 gravity oil in the now abandoned Bannatyne field. If areas of more permeable sandstone can be found, the probabilities of commercial production would be good.


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[1] Charles E. Erdmann, personal communication.
[2] Ibid.



ACKNOWLEDGMENT

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# North Central Oklahoma Offers Good Possibilities

**But it involves using today's tools to test the most-difficult-to-locate traps.**

**By ROGER R. PATTON,** Murphy Oil Company of Oklahoma, Inc.
Tulsa

THE COUNTIES OF Kay, Lincoln, Logan, Noble, Payne and Pawnee in north-central Oklahoma hold great promise of new oil reserves. Past production history shows the presence of good reservoir rocks and ample traps. Geologic study indicates additional accumulations of oil which can become the oil fields of tomorrow with the proper use of today's tools.

Late in the summer of 1904 the first oil well for this area was completed in the Cleveland Pool of Pawnee County. Since that time these six Oklahoma counties have produced in excess of 600 million barrels of oil and untold millions of cubic feet of natural gas. Some 36 reservoir rocks, consisting of sandstones, limestones, dolomites and detrital zones contributed, and still contribute, to this figure. These rocks range in geologic age from Ordovician to Permian and in depth from just under the "grass roots" to nearly 7000 feet. Average pool recoveries have been as high as 30,000 barrels of oil per acre and have ranged up to 300,000 barrels of oil per well. From one oil field, Tonkawa, has come 125,000,000 barrels of oil and some 70 other pools have each produced 1 million barrels, or more.

More than 325 pools represent the traps from which this oil has come and many of these are multi-zone with up to 9 or 10 separate pay horizons. Geologic studies of these pools show the traps, in which the oil was accumulated, to have been formed or affected by folding, faulting, erosion and sedimentary irregularities. During the year 1954 more than 100 new traps, or pools, extensions or new pay zones were discovered, 79 of which were oil bearing. Additional new traps are being discovered and developed this year and detailed studies indicate the presence of many yet to be found.

Beds of Permian and Pennsylvanian age are exposed at the surface over this area. The Hennessey shale (Permian), in western Logan county, is the youngest outcropping bed and the Vanoss-Ada Formations (Pennsylvanian), in eastern Payne and Pawnee counties, are the oldest of the surface formations. Petroleum reservoirs are found in both Permian and Pennsylvanian rocks. Those of the Pennsylvanian are, perhaps, the better known. Pennsylvanian sands are not "blanket" sands here, grading laterally into shales, limey sands and tight, impermeable sandstones. This characteristic is an important factor in the development of traps—stratigraphic traps or "pinchouts." Even limestones often develop porosity and permeability locally and grade into and out of sandstones, forming "closed reservoirs."

**Pennsylvanian beds** unconformably overlie the Mississippi limestone or the Chattanooga shale. The Mississippi limestone, when present, ranges up to 300 feet in thickness. On top of the limestone is sometimes found a weathered chert detrital, often called "cotton rock." When clean, this chert, named "Mississippi Chat," has porosity and permeability and forms a good "closed reservoir" for oil and/or gas. The Mississippi lime often produces from local porous zones, sandy phases and fractures.

Below the Chattanooga shale is another unconformity and in places over the eroded surface of the older beds is found the Misener sand. This coarse grained sand, similar in appearance to Wilcox sand, when clean, is often a good producer.

The Hunton limestone, lying just below the Chattanooga or Misener, as the case may be, varies in thickness from nearly 250 feet in the southwest corner of Logan county to 0 feet to the northeast. Porosity is found in dolomitic phases, coarsely crystalline and weathered zones.

The Viola limestone, producing in some pools, attains its fullest thickness

in the south and southwest parts of the area, where it is overlain by the Sylvan shale. To the north it is entirely absent and the Chattanooga shale may lie directly on the Simpson formation, except where locally separated by the Misener sand.

The Upper Simpson consists principally of dolomites, dolomitic limestones and sandy dolomites. These dolomites and sandy dolomites grade into First Wilcox sand, a "blanket" sand with local dolomitic or limey development forming impervious barriers.

The Marshall zone occurs just between the First and Second Wilcox sands. It consists primarily of shales, sandy shales, dolomites and sandy dolomites. Within this zone also can be found a locally developed sandstone member which may be productive of oil and/or gas.

**The Second Wilcox,** another blanket sand, is more uniformly developed in this area than the First Wilcox sand. Because of the extremely variable thickness of the Marshall zone, the structural anomalies of this sand do not always conform with those of the Viola limestones or the First Wilcox. The Second Wilcox sand is an excellent reservoir although its lower portion, as well as the older formations, is not too well known since most wells reach their total depth at or above its top. The entire Simpson section has a maximum thickness in the area of about 300 feet, thinning to the northeast because of erosion on top and onlap at the base.

Below the Simpson is the Arbuckle dolomite, another producer of oil in this area. The top of the Arbuckle is an erosional surface, but too little is known about its overall characteristics as very few wells have penetrated its entire section.

This, briefly, outlines the stratigraphy and some of the reservoir rocks which have produced, and are still producing, oil and gas. Many of these reservoir rocks, by their very nature, form excellent traps without benefit of structural closure. These stratigraphic traps and anticlinal features of low relief hold the oil fields of tomorrow.

Structurally, these counties are part of the Northeast Oklahoma platform area, crossed on the extreme west edge by the Nemaha ridge, with the beds rising gently to the northeast toward the Chautauqua arch and eastward toward the Ozark uplift. Well to the southeast and south lie the McAlester Basin and the Pauls Valley uplift. Ordovician rocks dip to the west and southwest at the rate of around 50 to 100 feet per mile, except for local irregularities. Younger rocks dip in the same direction and normally with much less local relief. Except along the Nemaha ridge, major faulting trends NE-SW or E-W and usually is pre-Pennsylvanian or older.

The principal tools available for exploration in this area are those of an indirect approach to finding oil. Geology and its allied sciences have, in the past, satisfied themselves with searching for "folds" with the fervent hope that, when found, they would have fulfilled their destinies.

Surface geologic mapping was one of the early tools used here and met with considerable success, but it had its weaknesses. Surface structures are not always true and exact reflections of deeper structural closures which may be present. Unconformities may mask the presence of buried anticlines and stratigraphic traps will remain undetected by the surface geologist. Too, in some localities, outcrops are either non-existent or unreliable. This area has been pretty well covered by "pick and hammer" men, so new surface work here could not be expected to be of any value. However, new ideas can be gleaned from restudies of old maps.

**Core drilling** was a big aid to surface geology in areas lacking in good reliable exposures but it, too, failed to reach the masked depths. This tool, like the first, has reached the point where its chief value is in reviewing old work for new clues.

Seismology was, and is, an effective tool and last year these counties saw some 185 crew-weeks of seismic activity. Remarkable improvements in instruments, techniques and interpretation have been made in this geophysical tool in recent years, which necessitated reworking old areas as well as reviewing old records. The seismograph still has its limitations, however, and should never be considered as other than one of several exploration tools. In areas of low relief structures, the limit of error of this instrument can cause actual "closures" to remain undetected and indicate the presence of non-existent ones. The technique for the location of stratigraphic traps has not been fully perfected. Continued improvements should increase the value of seismology, but it cannot supersede the well-rounded exploration program with all


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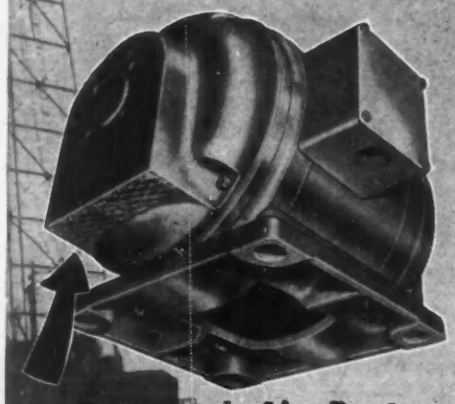

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tools receiving just consideration.

Subsurface geology, as an exploration tool, was of no value in the early development of this area but is now the most important of all tools. Each well drilled added something to help clarify the geological picture of what lies below the surface and how it lies. Modern drilling, logging and testing methods combine to give increasingly valuable data. Detailed studies of drilling time logs, sample logs, electric logs, gamma ray-neutron logs and cores develop valuable information as to both structural position and stratigraphic development of the subsurface formations at the well site. Comparisons with similar data from nearby wells will indicate structural and stratigraphic "tie-ins" between the wells. Subsurface mapping, in local detail for each possibile producing horizon, showing structural contours, isopachs, isochores and cross sections, will involve much concentrated effort and time but can be exceedingly rewarding.

**Petroleum exploration** now has a more direct tool than any of these. Actually, it is a modern version of the first tool ever used—the oil seep. This modern counterpart is the data on oil and/or gas shows encountered in drilling wells. Samples, cores, drillstem tests and actual production tests indicate by oil stain, taste, odor, fluorescence, and even free oil, the presence or near-presence of a petroleum reservoir. Electric logs may also indicate possible oil shows.

The judicial use of all available tools, co-mingled with a little geologically guided imagination, will point out locations for the bit to drill. The properly guided and supervised bit is, in the final analysis, the tool which actually "discovers" the oil. The phrase "properly guided and supervised bit" indicates the second step of petroleum exploration—that of supervision of drilling and testing exploratory wells. The importance of this phase has been pointed out in recent years by the simple expedient of opening up new oil and gas pools around abandoned "dry holes."

The exploration supervisor on each drilling well must see that the drilling mud is adequate, that the hole is drilled sufficiently near the vertical and that all possible reservoir rocks are thoroughly evaluated and properly tested for oil and/or gas production. In addition to its value for mechanical reasons, adequate drilling mud is


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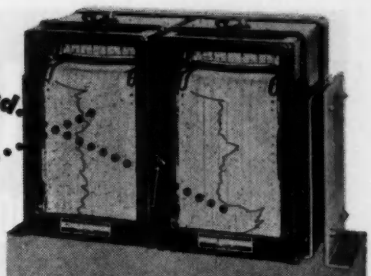

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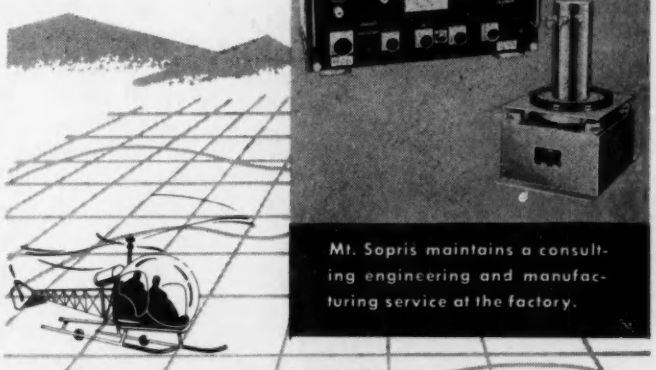

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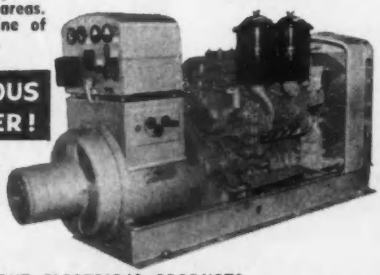

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necessary to improve the quality of the well cuttings, to eliminate as much as possible the flushing of oil and/or gas from the cuttings and cores, and to retard the penetration of the petroleum reservoir by the mud filtrate. The value of a straight hole in structural calculations can be readily seen. The evaluation of the commercial possibilities of a wildcat well from an examination of samples alone is a virtual impossibility. True, the experienced observer can obtain a general idea of the physical characteristics of the reservoir rock, but this can be, and often is, misleading. Acid and fracture treatments have been very successful in many producing zones of this area, in spite of the appearance of the zone at the well bore. Flushing action of the mud filtrate (which cannot be entirely eliminated), gas and near colorless oil content, and other factors, can make the detection of oil and/or gas in well samples difficult, if not impossible. Any indication of the presence of oil and/or gas, however minute, in a wildcat well, should be followed by coring and/or drillstem testing. On reaching the total depth of a well, an electric log should be run and at that time all available data should be considered before casing is run or the well abandoned as a dry hole. Samples, drilling time, cores, core analysis, results of drillstem tests, electric logs—all are important tools, not one of which is independent of the others. It should be remembered that the primary consideration in drilling a well is to find oil and/or gas in commercial quantities and not the establishment of new records for drilling speeds, reduced costs, etc.

**Production history** of these six counties has proven the presence of good reservoir rocks and accumulations of oil and/or gas have been found in various types of traps. Many, if not most, of the more prominent and obvious structural traps have already been tested. The less prominent structural traps and stratigraphic traps, which are the most difficult to locate but not necessarily any less productive, are the future objectives in this area. Although the task is more difficult, the exploration tools of today are much more proficient than they were in 1900. It will take more study, more concentrated effort and more specialization in this area but there is reason to believe that the next 50 years will see an equal, or even greater, production record. —**The End**


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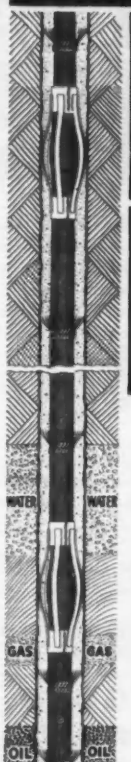


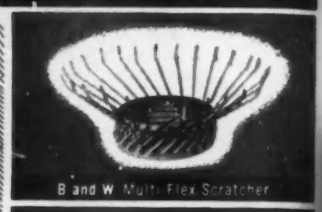
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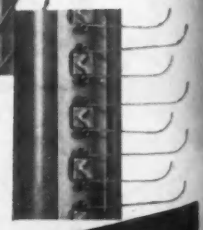
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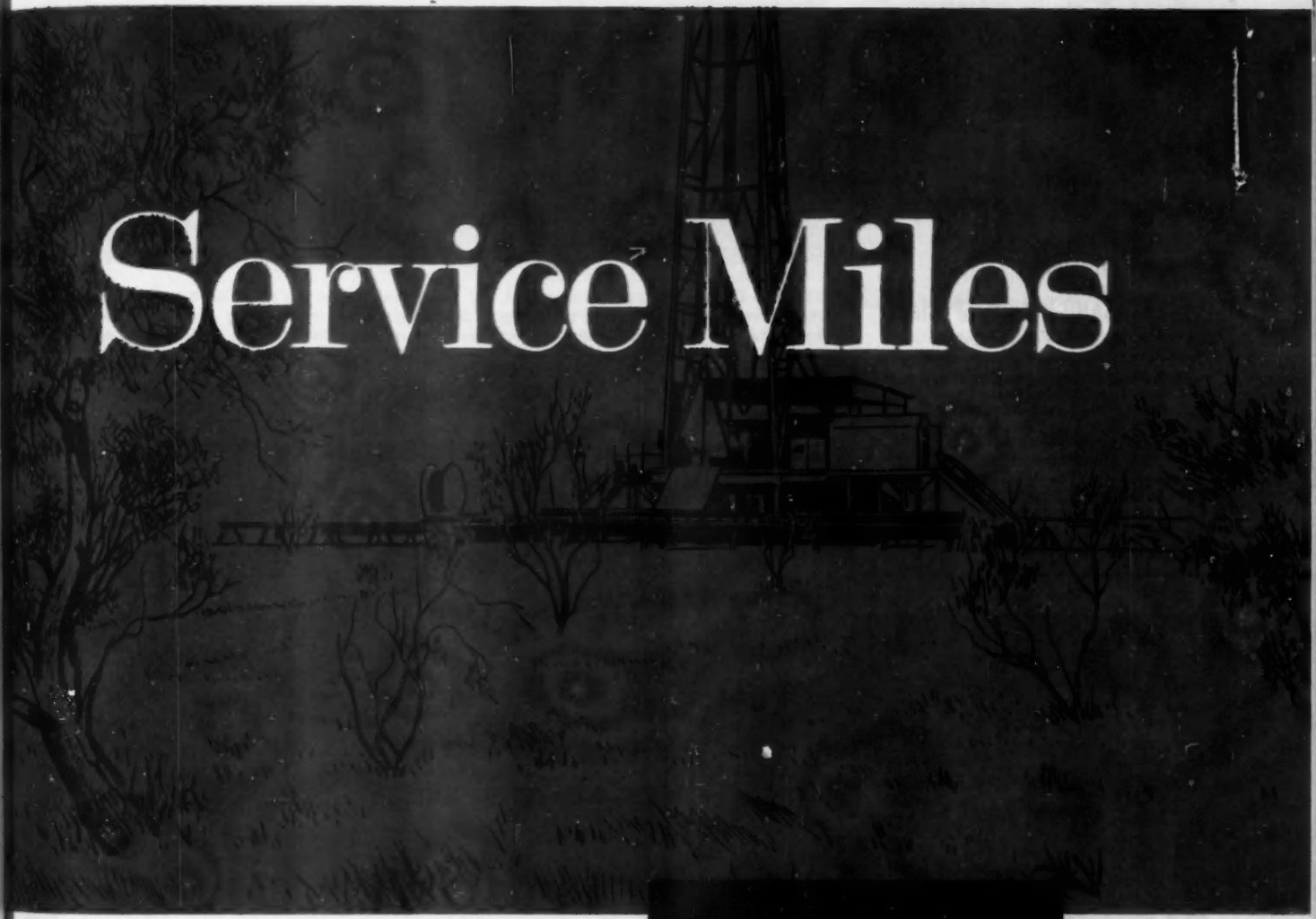

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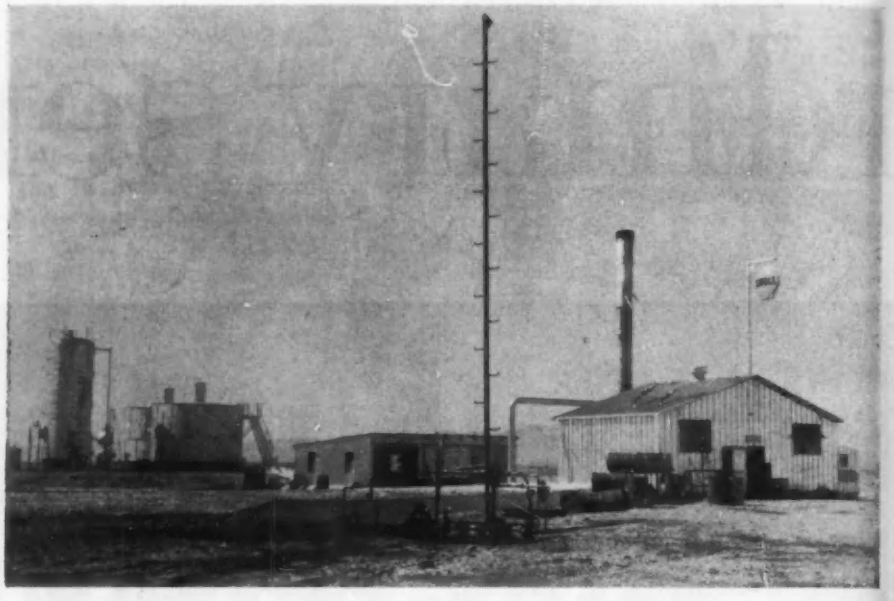


Shell Oil Company's Eagle Springs Unit No. 1, original discovery well which brought Nevada into the roster of states producing oil and gas. Central power plant delivering power oil to subsurface hydraulic type pumps is located in shed immediately beyond well. Three wells are on production in this field.

# Exploration Continues in Nevada

**Planned exploratory effort may expand production picture.**

DESPITE CONTINUING exploratory efforts in various parts of Nevada, Shell Oil Company's discovery area in Railroad Valley, some 65 miles southwest of Ely, still is the only commercial production thus far established in the state.

The photograph here is Shell's original discovery well, one of a total of three producing wells all of which now are on production. The discovery well, Eagle Springs Unit No. 1 was completed on the pump in June, 1954, producing at a rate of approximately 200 barrels per day of high pour point, 28 gravity crude from Tertiary agglomeritic material from open hole interval 6450-6730 feet.

Since that initial completion which, incidentally, was Shell's first test of the area, the company has drilled six other wells in the Railroad Valley sector; four of them being dry holes and two being successful completions. All three successful wells produce from about the same general depth and from the same type of formation. The three producers, forming a roughly triangular pattern, would indicate an estimated proven area (based on these wells) of around 250 acres.

The crude oil has an unusually high pour point of between 80 and 90 degrees, a fact which makes it very difficult to handle and requiring steam and hot-oil traced flow lines and heated, insulated tank facilities. The wells currently are being produced by hydraulic type pumps powered by a central power oil pumping plant. Current production from all three wells is being held to approximately 175 to 200 barrels per day, the oil being taken by heated tank trucks to a Salt Lake City refinery, a distance by highway of slightly in excess of 300 miles.

No further drilling is being done, at the present time, in the Railroad Valley area by Shell, although it is understood that the company is contemplating some exploratory activity in another part of the state farther east. Richfield Oil Corporation, it is understood, shortly will start a wildcat test near the town of Elko, in the northeastern corner of the state. —**The End**

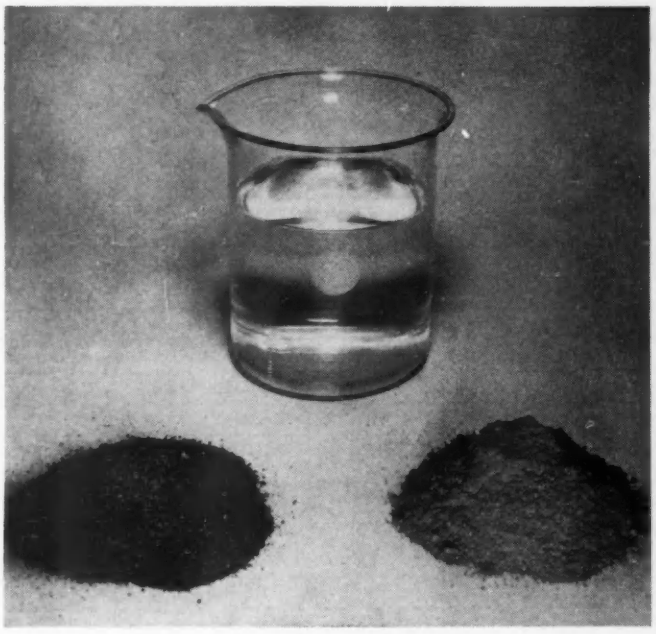


FIGURE 1—Aluminous cement ingredients: 35 percent inhibited phosphoric acid (37) in beaker, powdered fluoride accelerator (E10), at left, powdered aluminous material (E32), right.

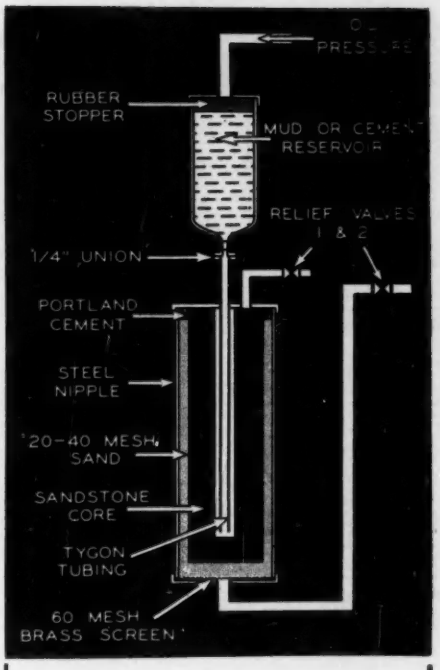



FIGURE 2—Tests, indicating the extent to which the new, complex aluminous cement bonds to a mudded formation surface, are made with equipment such as the above. A 3½-inch diameter core is used. First, a 1¼-inch hole is drilled into the core to a depth of approximately 22 inches. Core is then placed in a 4-inch steel nipple, packed with sand, and sealed at the top with portland cement.

To apply a mud cake to the surface of the 1¼-inch hole, a reservoir of mud is attached with a 1¼-inch union. Relief valve No. 1 is opened, and oil pressure is applied until there is a show of mud. Valve No. 1 is then closed, and valve No. 2 is opened. Pressure of 100 psi is then applied to the mud for one hour. Fact that relief valve No. 2 is open permits fluid loss through the core.

After one hour, pressure is relieved. The mud reservoir is replaced with a reservoir filled with aluminous cement slurry. Relief valve No. 2 is then closed and relief valve No. 1 is opened. Oil pressure is applied until a show of cement is obtained through valve No. 1. An additional 500 milliliters of the cement is displaced. Valve No. 1 is then closed and valve No. 2 is opened. A pressure of 200 pounds is applied and the same is left for 48 hours at 175° F.

# New Aluminous Cement Developed for Oil Wells

**An accelerator controls the working and setting time for a temperature range of 70° F. to over 300° F. Early tests indicate a superior cementing product, with better pipe to formation bond, developed especially for the oil industry.**

**By J. S. TALBOT,** District Manager, Dowell Incorporated, Houston, and **ANTHONY GIBBON,** WORLD OIL Staff

A COMPLEX aluminous cement, the first completely new cement ever to be designed especially for oil and gas well usage, has been developed and is now available to the industry. It is not Portland cement with new additive agents, nor is it a plastic. It is an entirely new material; a mixture of an acid and two solids which form an easily handled slurry. An accelerator makes it possible to control the working and setting times of the cement for various temperatures. The present mixture can be used over a temperature range from 130° F. to 200° F. Other mixtures are being developed which will allow its use from 70° F. to over 300° F.

**Principal advantages** claimed for the new cementing material:

1. No shrinkage.
2. Toleration of relatively great contamination by drilling fluids.
3. High bonding strength.
4. Low fluid loss.
5. Assimilation or cementation of filter cakes.
6. Uniform slurries.
7. Resistance to shattering.
8. Controlled setting time at various temperatures.

The slurry is a mixture of three materials (Figure 1): 35 percent inhibited phosphoric acid, a powdered aluminous material containing a viscosity control agent, and a powdered fluoride material which acts as the accelerator or setting-time-control agent.

The new cement can be used in any oil well cementing job where present

**TABLE 1—Field Results of Cementing Jobs Using Aluminous Cement**

| Type of Job | Depth | Bottom Hole Temperature | Cu. Ft. of Cement Used | Remarks |
|---|---|---|---|---|
| Long String | 5639 feet | 160° F. | 500 | Perforations above high-pressure water sand gave dry test. Offset well in which regular Portland cement was used required a squeeze job in this zone. |
| Long String | 5610 feet | 150° F. | 500 | Test made gas and distillate, no water. |
| Squeeze | Packer set at 4837 feet | 140° F. | 170 | Top of cement found at 4837 feet; calculated two barrels had flowed back. Perforated 4826 to 4827 feet. Produced water. |
| Squeeze | Packer at 4823 feet; perforations at 4826 to 4827 feet | 135° F. | 135 | Dry test at 4810 feet. Perforated for production at 4815 to 4824 feet. |
| Long String | 6140 feet | 144° F. | 1050 | Perforations from 6056 to 6057 feet showed oil and gas, no water; perforations from 6057 to 6060 feet showed oil and gas, no water. High gas-oil ratio. |
| Squeeze-shut off high gas-oil ratio | 6056 to 6060 feet | .... | 100 | Gas shut off. |
| Squeeze to shut off water | 6075 to 6076 feet | 150° F. | 135 | Dry test. |
| Long String | 5693 feet | 150° F. | 455 | Perforated just above high-pressure water zone into zone producing pipe line oil. |
| Long String | 5510 feet | 150° F. | 1000 | Checked fill-up with Radio-active material added to cement. |
| Squeeze off water zone | 4755 to 4760 feet | 150° F. | 170 | Dry test. |
| Set Liner | 4985 to 5087 feet | 173° F. | 65 | Perforated and made pipe line oil on test. |
| Long String | 7560 feet | 175° F. | 700 | Producing gas and distillate, no water. Perforated 8-foot zone. |
| Plug Back for Whipstock | ..... | 150° F. | 85 | Plug set successfully. |

**TABLE 2**

**Miscellaneous Data On Aluminous Cement**

| | |
|---|---|
| Density of slurry | 11.5 to 12.2 pounds per gallon |
| Density of slurry under pressure | 13.4 pounds per gallon |
| Viscosity of slurry | 350 to 400 centipoises |
| Gel strength of slurry (Initial) | 10 to 15 grams |
| (After 10 minutes) | 10 to 25 grams |
| Fluid loss of slurry | 30 to 60 milliliters in 30 minutes (Depending on amount of E10) |
| Density of Set Material | 13.4 pounds per gallon |
| Permeability of Set Material | Approximate 0.005 millidarcys |
| Porosity of Set Material | Approximately 7 percent |

day cementing materials are now used. One of its most important advantages is that the working and setting times of the slurry can be controlled accurately. Tests show that the new cement gives an improved bond to the pipe and formation. More than 20 percent mud by volume can be incorporated into the new slurry without causing failure to the set thus minimizing the use of pipe scratchers. The cement has extremely low permeability and porosity, and under well conditions shows no evidence of shrinkage.

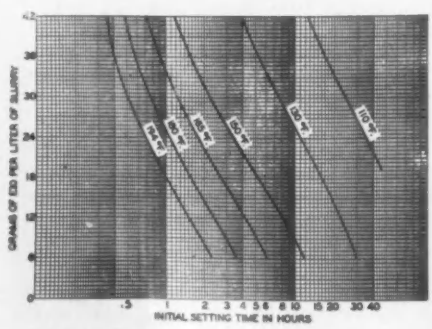
The fluid loss of the slurry is much lower than that of present cementing materials, assuring maximum fill-up for given volumes of slurry. This also means that the viscosity of the slurry will remain relatively constant during the job, and minimizes the possibility of obtaining false sets.

The properties of the new cementing material are such that it can be readily drilled and perforated by conventional methods. In perforating, the danger of fracturing is less than with other cements. Laboratory tests have perforated it at a compressive strength as low as 400 pounds per square inch without fracturing or shattering. It can also be perforated after extended periods of time.

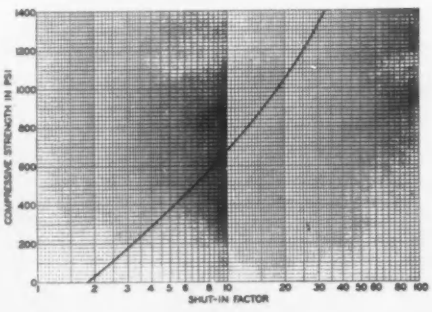
Several factors contribute to the uniformity of the slurry. Mixing can be done in batches because the setting time can be regulated. Materials are stable in storage and manufactured under strict quality controls.

The density of the slurry is 13.4 pounds per gallon when under pressure. With minor changes, the density can be increased to 16 pounds per gallon. The density is somewhat less at atmospheric pressure because of a slight evolution of gas during the mixing process, but the small amount of gas causes no difficulty during cementing operations, although it does require some change in the usual laboratory testing procedures.

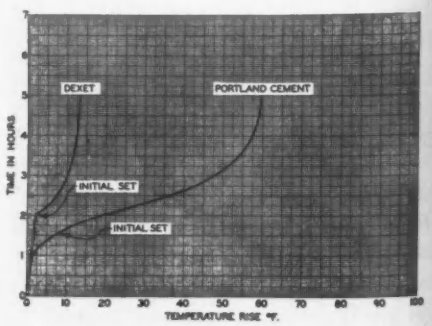
Table 1 gives the field results of cementing jobs using the new cementing material. —**The End**




**CURVE 1—Initial setting time. These curves show the initial setting time of cement slurry at six different temperatures as measured by the Vicat method.**




**CURVE 2—Shut-in factor. This curve shows the shut-in factors used to calculate the well shut-in time necessary to obtain desired compressive strengths in set aluminous cement. The factor is used in the formula: WELL SHUT-IN TIME = SHUT-IN FACTOR X THICKENING TIME. Shut-in times determined by this method will give comprehensive strengths equal to or greater than that shown by the curve.**




**CURVE 3—Heat of reaction. This curve compares the heat generated as aluminous slurry sets with the heat generated as portland cement slurry sets.**

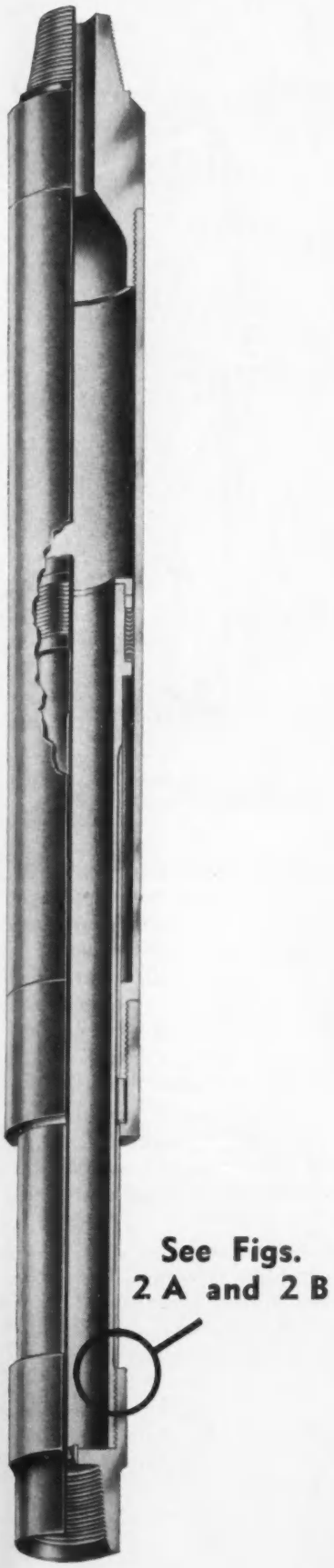



FIGURE 1—Hydraulic drill collar assembly.

# Hydraulic Drill Collars Increase Drilling Efficiency

**Drill string and rig vibrations have been dampened and in some cases penetration rates increased through the use of this new hydraulic shock absorber.**

**By ALAIN SELIGMAN**
Directo Corporation, Houston

VIBRATIONS IN rotary drilling affect penetration rate, life of the drill string and life of the drilling rig itself. Until recently, little has been known to substantiate this statement factually. Studies have been made on the buckling characteristics of the drill string.[1] These apply to a non-rotating drill string, however, and give only an incomplete picture in a rotating string. This article deals with actual field results in rotary drilling, an interpretation of those results and some conclusions made concerning vibrations.

In the belief that certain vibrations that affect drilling efficiency did exist, a hydraulic drill collar or shock absorber was designed. Extent of these vibrations, and the tendency for the drill bit to leave bottom, were not known until actual comparative field runs were made.

The hydraulic drill collar consists mainly of two elements; a fixed cylinder attached to the lowermost drill collar, and a telescoping tube which operates as a piston within the cylinder. Rollers and grooves in the two members act as a spline combination to transmit rotation to the drill bit. The pressure differential of the mud forces the telescoping tube downward. Thus a relatively constant weight is maintained on the bit independent of the vibrations within the drill string.

The telescoping tube has a total free stroke of 2½ feet with respect to the cylinder. However, for the theory about vibrations to be correct, it was felt that in operation at the bottom of the hole the free stroke would be considerably less than 2½ feet. Original field testing in West Texas and New Mexico proved that this condition existed. In most cases, the effective drilling stroke was two feet.

The hydraulic drill collar is run with just enough weight on the bit to be sure that the telescoping tube is in fully retracted position. Then the pump and rotary are started with the brake tied down. As pressure builds up, the bit is forced downward hydraulically and the drill collars are pushed upward hydraulically. As the drill bit cuts its way downward, the sliding tube will feed out of the cylinder, its stroke limited to 2½ feet by a retaining shoulder. Because of the string vibrations a few inches from the end of the stroke, the shoulder on the sliding tube will hit the shoulder on the cylinder. Then there will be weight on the bit. Since a weight indicator is a highly damped instrument, it will only register the average of those weights. After an average of about two feet has been drilled, a gradual decrease in weight is observed. This is because there were a few inches of relative motion between the sliding tube and the cylinder. This indicates that there is considerable vertical vibration in a rigid drill string.

Another good example of the tremendous impact of vibrations in a drill string occurred when drilling in anhydrite and gyp formations in the West Texas-New Mexico area. While drilling with a conventional string,

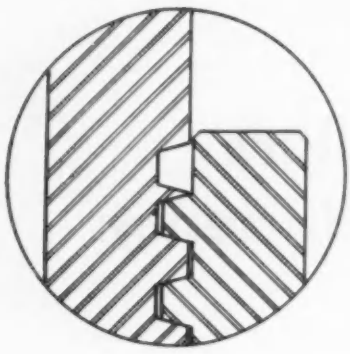


FIG. 2A

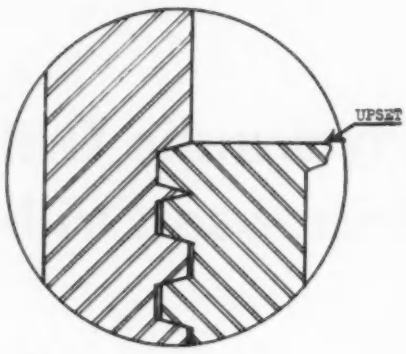



FIG. 2B

**FIGURE 2—New design of bit sub thread (2a) to prevent the upset both externally and into the stress relieve groove (2b).**

considerable vibrations were observed with the kelly jumping up and down in the kelly bushing as much as 2 feet. After the 12¼-inch hydraulic drill collar was placed in the string, those vibrations were eliminated completely.

When the casing point was reached and the hydraulic drill collar was broken down, the bit sub was very hard to break and did not spin off freely. A closer examination revealed that the outside top corner of the bit sub was upset towards the outside about ⅛-inch. (See construction bit sub thread cut in Figure 2A.)

The top shoulder of the bit sub, when it hits the bottom of the cap, limits the stroke of the hydraulic drill collar. When vibrations occur, and the hydraulic drill collar is in its fully retracted position, impact forces would be expected on these two surfaces. In this instance, impact was sufficiently great to upset the top of the bit sub into the stress relief groove as shown in Figure 2B.

With the close tolerances used in the hydraulic drill collar both shoulders make contact around a complete annular space. With the metal used on this bit sub it would require, statically speaking, approximately 3 million pounds to make that much metal flow. This problem has been solved by cutting a large enough thread relief groove in the sub so there will be no interference in spite of the upsetting.

However, it was still difficult to believe that so much energy existed at the bottom of the hole, although field results showed it to be there.

The following theory was then developed. It had been well known for some time that pipe tends to form a helix and follow the wall of the hole, thus the following assumption:

1. The drill pipe will contact the hole at the OD of the drill pipe and not at the OD of the tool joint.

2. The hole will be contacted approximately every 60 feet, or there will be one helical revolution every 60 feet.[3]

3. The stress in the drill pipe will be approximately 30,000 psi. This stress being somewhat over the endurance limit of the drill pipe.

Although the assumptions do not pretend to be accurate, they will be used for illustrating purposes. If a picture of the drill string is drawn according to the assumptions mentioned above, something like that shown by Figure 3 would result. In other words the drill pipe in a hole acts as a big helical spring. If that were the case, how much energy could be stored in that big helical spring? Consider a 12¼-inch hole with 6000 feet of 5½-inch drill pipe being used. For the time being the drill collars—their length and sizes—will be ignored. Using standard methods for determining the amount of energy stored in the spring, it is found that 2,192,000 foot pounds of energy can be stored in the spring under the above conditions. This would explain the upsetting of the surfaces. These figures were used as an illustration of what may happen at the bottom of the hole. It is the only way, the author feels, that that much energy can be stored in the hole.

Some work was then done to determine the frequency at which those vibrations occurred and their amplitudes. At this time nothing has been found that is satisfactory. It must be remembered that a frictional force, proportional to the speed at which a vibrating body moves, will tend to lower the frequency and definitely limit the amplitudes.[4] On the other hand, a frictional force that is not proportional to the speed at which the vibration occurs will not affect the

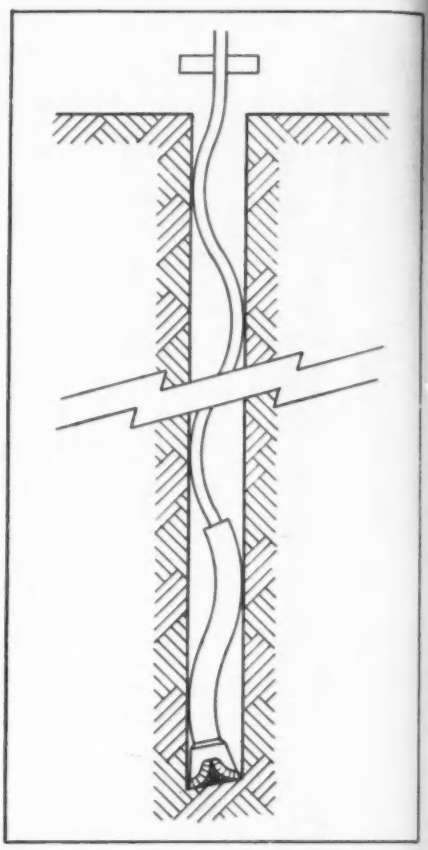


**FIGURE 3—Assumed position of drill stem when rotating in compression.**

frequency, nor will it limit the amplitude. This will show how the length and weight of the drill collar string will tend to vary the frequency. A longer or heavier drill collar string will tend to lessen the frequency and lower the amplitude of the vibration. By the same token, a heavy drilling mud will do the same thing.

This whole theoretical approach has been made on the assumption that the drill string vibrated regardless of other conditions, as formation drilled, type of bit, etc.

It is known that there are conditions where the 12¼-inch hole in conventional drilling is extremely rough; other conditions where it is not. What are the factors that effect it? It is believed that the impact energy absorbed by the formation will either tend to dampen drill string vibrations, or cause it to vibrate that much more. If the coefficient of restitution is very high, the drilling should be very rough. If the coefficient of restitution is very low, the drilling should be rather smooth.

The coefficient of restitution is the amount of energy absorbed by the formation. For instance, a steel ball dropped from a height of two feet on

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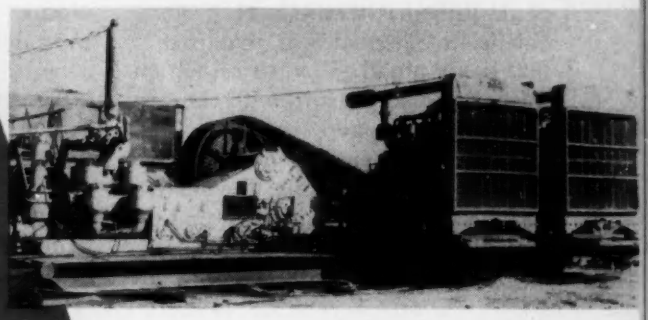

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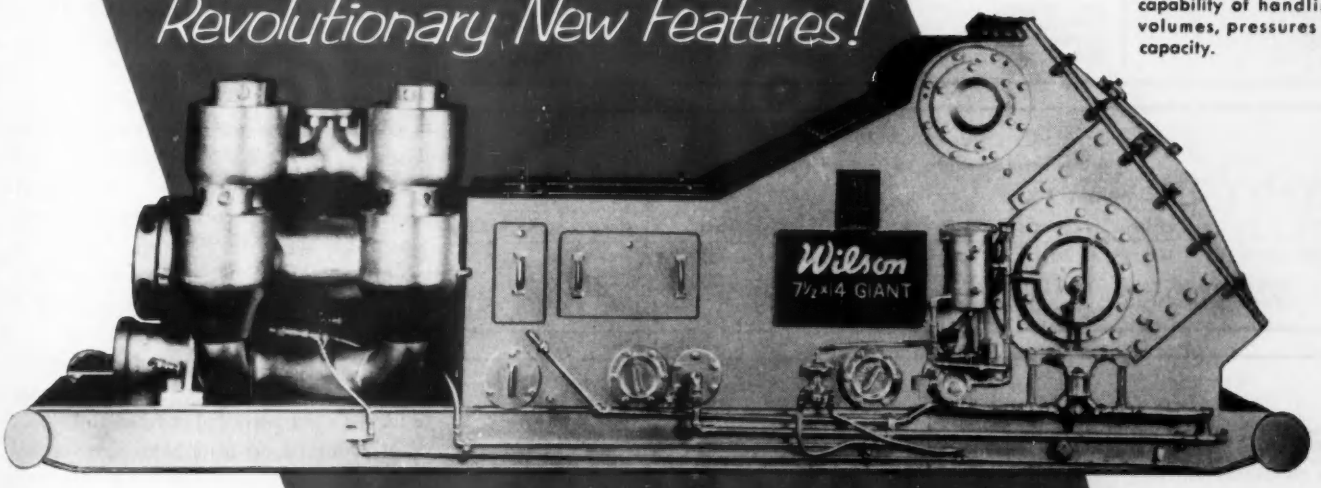


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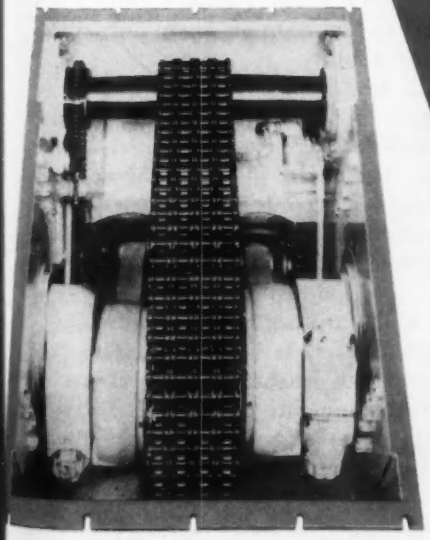

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to a piece of formation bounces back to a height of one foot; the coefficient of restitution is then 0.5. Half of the kinetic energy that was imparted to that ball is absorbed by the formation. The other half remains with the steel ball, which bounces back only half the original distance. Some tests have been made to determine the relative coefficient of restitution of formations normally encountered in drilling. These tests are expected to be completed in the near future. It is believed that the roughness of drilling certain formations can be predicted accurately by making a simple test on cores.

Some of the results obtained by the hydraulic drill collar are startling. All the results are not known at this time, as it is difficult to determine the additional life that can be given to a string of pipe or drill collars.

With a lot of clearance between the drill pipe and the wall of the hole there is a lot of vibration. These vibrations are translated into very early fatigue failures of the drill string, and even failure of surface equipment. These extremely high vibrations can be eliminated almost completely by inserting a hydraulic drill collar and using sufficient pump pressure so that pressure differential across the hydraulic drill collar will place proper weight on the bit.

If the hydraulic drill collar is fully extended, vibrations are felt in the string. If more weight is slacked off on the bit than is developed hydraulically at the bit some very heavy vibrations can be felt. It is only in that middle range that these vibrations can be reasonably quieted out.

A good illustration of extreme vibrations was a case in West Texas, where the drilling contractor had trouble in breaking his drill collar joints every trip. After the first run was made with the hydraulic drill collar, the trouble was eliminated and was not encountered again as long as the hydraulic drill collar was used.

One area where a number of these runs have been made is in a Wyoming field. In that particular field the Phosphoria, Tensleep and Madison formations are extremely hard and drilling rates are low. For a long time these formations were diamond cored or diamond drilled at a high cost. Since the advent of tungsten carbide insert bits some great improvements have been made in drilling these formations. The use of the hydraulic drill collar and these tungsten carbide insert bits seems to have helped the penetration rate in these formations considerably.

A few partial bit records will be given to show what can be done by keeping that bit firmly seated against the bottom of the hole. More complete bit records will be enclosed as an appendix. Two locations are used: A and B. On both of those locations some of the drilling was done conventionally, and some with the hydraulic drill collars. It is interesting to note that with carbide bits increase in penetration rate due to the hydraulic drill collars was identical on both locations.

An 8¾-inch small hole was drilled on location A and an 8⅝-inch small hole was drilled on location B. The following is a comparison of the carbide bit runs on location A and B in the Tensleep and Phosphoria.

**TABLE 1**

| LOCATION | Type of Run | No. Bits | Footage | Hours | Drilling Rate Feet/Hour | Average Feet Per Bit |
|---|---|---|---|---|---|---|
| A | Conventional | 11 | 505 | 172 | 2.93 | 45.9 |
| A | Hydraulic | 3 | 120 | 35.5 | 3.38 | 40 |
| B | Conventional | 4 | 169 | 75.15 | 2.23 | 42.2 |
| B | Hydraulic | 10 | 456 | 140.00 | 3.25 | 45.6 |

**TABLE 2**

**From Intermediate to Top of Phosphoria**

| LOCATION A | | | | LOCATION B | | | |
|---|---|---|---|---|---|---|---|
| From To | Footage | Hours | No. Bits | From To | Footage | Hours | No. Bits |
| 8200—10,159 | 1959 | 293½ | 36 | 8226—10,059 | 1833 | 294 | 29 |
| Drilling rate 6.67 ft./hr. Footage per bit 54 ft./bit | | | | Drilling rate 6.23 ft./hr. Footage per bit 63 ft./bit | | | |

**TABLE 3**

| LOCATION A | | | | LOCATION B | | | |
|---|---|---|---|---|---|---|---|
| From To | Footage | Hours | No. Bits | From To | Footage | Hours | No. Bits |
| 10,159—11,010 | 861 | 358 | 21 | 10,059—10,924 | 865 | 296¾ | 22 |
| Drilling rate 2.40 ft./hr. Footage per bit 41 ft./bit | | | | Drilling rate 2.91 ft./hr. Footage per bit 39 ft./bit | | | |

**TABLE 4a**

**Before Hydraulic Drill Collar**

| LOCATION | Footage | Hours | No. Bits | Drilling Rate | Footage per Bit |
|---|---|---|---|---|---|
| A | 651 | 284½ | 14 | 2.28 | 46.5 |
| B | 212 | 92¾ | 5 | 2.28 | 42 |

**TABLE 4b**

**After Hydraulic Drill Collar**

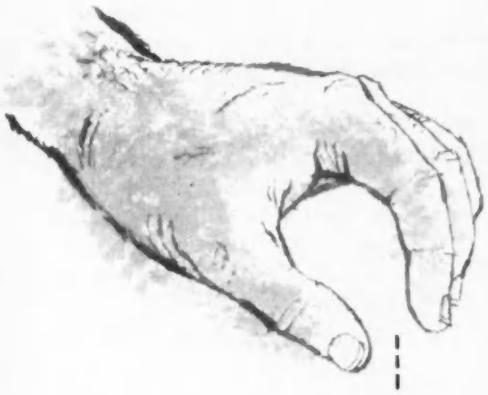
| LOCATION | Footage | Hours | No. Bits | Drilling Rate | Footage per Bit |
|---|---|---|---|---|---|
| A | 210 | 73.5 | 7 | 2.85 | 30 |
| B | 653 | 204 | 17 | 3.20 | 38 |

**TABLE 5**

| LOCATION C—Conventional | | | | LOCATION B—Hydraulic | | | |
|---|---|---|---|---|---|---|---|
| From To | Footage | Hours | No. Bits | From To | Footage | Hours | No. Bits |
| 10,890—11,481 | 591 | 124 | 11 | 10,924—11,451 | 530 | 84 | 5 |
| Drilling rate 4.77 ft /hr Footage per bit 54 ft /bit | | | | Drilling rate 6.31 ft /hr Footage per bit 106 ft /bit | | | |

**TABLE 6**

| HYDRAULIC RUNS | | | | CONVENTIONAL RUNS | | | | |
|---|---|---|---|---|---|---|---|---|
| Well Name | Footage | Hours | Pen. Rate Ft./Hr. | Well Name | Footage | Hours | Pen. Rate Ft./Hr. | Percent Increase |
| D | 3213 | 212 | 15.1 | E | 3261 | 287.5 | 11.3 | 33.6 |
| F | 554 | 30¼ | 18.3 | G | 512 | 35.75 | 14 3 | 27.9 |
| H | 1306 | 81.5 | 16.0 | I | 1564 | 122.75 | 12.8 | 25 |
| H | 258 | 20.5 | 12.0 | I | 327 | 33.75 | 9.7 | 23.7 |
| J | 893 | 29.75 | 30 | K | 739 | 31.75 | 23.2 | 29.3 |
| L | 1136 | 106.5 | 10.65 | L | 908 | 109.25 | 8.33 | 26.9 |



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A total of 28 carbide bits was run. Of these, six carbide bits with the hydraulic drill collar drilled at a rate faster than 3.4 feet per hour. They were bits 99 and 100 of location A, and bits 84, 85, 87 and 92 of location B. Only one carbide bit drilled faster than 3.4 feet per hour without the hydraulic drill collar. That was bit 98 of location A. Below is a tabulation of all the 28 carbide bits.

In drilling from the intermediate casing point to the top of the Phosphoria, wells A and B had almost identical drilling rates. However, the footage per bit was much better on well B. This is believed to be because some sharp sand stringers were encountered in that formation. Table 2 is a tabulation of all runs in that formation. All were drilled conventionally.

Table 3 is a tabulation of all the bits run on both locations through the Phosphoria and Tensleep.

If all bits run before the introduction of the hydraulic drill collar are compared with the conventional run results after the hydraulic drill collar was used, the following results. On location A the hydraulic drill collar was picked up at 10,806 and on location B at 10,271.

On location A, bit 101, run conventionally, only made four feet in 3¼ hours. On location B bit 81, run conventionally, only made 4 feet in 5¼ hours. These two bits lower the footage per bit considerably.

It is interesting to note that the Phosphoria and Tensleep were drilled at exactly the same speed under the same conditions on both locations, and increased the drilling rate 33 percent. A comparison of drilling rates below the Tensleep is impossible between locations A and B as the Tensleep is faulted on location A. The Amsden Shale and Madison Lime below the Tensleep are not comparable between locations A and B. This lower section will be compared between locations B and C, the best previous well drilled in that field. Table 5 is a tabulation of the bits used to drill the formation in these two wells.

It is interesting to note that the increase in penetration rate, due to the hydraulic drill collars, was much the same in these two formations as it had been in the Phosphoria and the Tensleep. The footage per bit is almost 100 percent greater on location B. Two carbide bits were used on location B, while none were used in drilling the Madison and Amsden Shale on location C. This is believed to have influenced the footages per bit.

Similar results have been obtained in West Texas. Comparison wells are drilled by the same rig and are either the nearest offset or alternate runs.

There was a case of extremely heavy vibration in the drilling of the intermediate hole in the Wyoming field. On the previous well, drilled by the same rig, a number of fishing jobs occurred while drilling the intermediate hole. In this field the 12¼-inch hydraulic drill collar was in the hole. In this field the 12¼-inch hole was drilled from under surface to 8200 feet. The hydraulic drill col-

**Continued on Page 122**

**TABLE 7**
**Well A**

| Run No. | Size | Make | Type | Jet Size | DEPTH From | To | Feet | Hours | Weight On Bit | |
|---|---|---|---|---|---|---|---|---|---|---|
| 86 | 8¾ | HTC | W7RJ | 11 | 10,159 | 10,182 | 23 | 5¼ | 70 | Conv |
| 87 | 8¾ | Solid | | 5/16x3/16 | | 10,266 | 84 | 47¼ | 10–14 | Conv |
| 87 | 8¾ | Solid | | 5/16x3/16 | | 10,336 | 70 | 48 | 14 | Conv |
| 88 | 8¾ | HTC | R-1 | 11 | | 10,347 | 11 | 9½ | 24 | Conv |
| 89 | 8¾ | HTC | R-1-J | 12 | | 10,424 | 77 | 23¼ | 40 | Conv |
| 90 | 8¾ | Solid | | 5/16x3/16 | | 10,434 | 10 | 6¼ | 14 | Conv |
| 91 | 8¾ | HTC | R-I-J | 12 | | 10,476 | 42 | 12½ | 30 | Conv |
| 92 | 8¾ | HTC | R-I-J | 12 | | 10,544 | 68 | 22 | 30 | Conv |
| 93 | 8¾ | HTC | R-I-J | 12 | | 10,587 | 43 | 20 | 30 | Conv |
| 94 | 8¾ | HTC | R-I | 11 | | 10,644 | 57 | 20 | 40 | Conv |
| 95 | 8¾ | HTC | R-I | 11 | | 10,702 | 58 | 19¼ | 40 | Conv |
| 96 | 8¾ | HTC | R-I | 11 | | 10,744 | 42 | 13¾ | 40 | Conv |
| 97 | 8¾ | Solid | | 5/16x3/16 | | 10,762 | 20 | 25¾ | 14–18 | Conv |
| 98 | 8¾ | HTC | R-I-J | 12 | | 10,806 | 44 | 11½ | 34 | Conv |
| 99 | 8¾ | HTC | R-I-J | 5/16 | | 10,856 | 50 | 13 | 34 | Hyd |
| 100 | 8¾ | HTC | R-I-J | 5/16 | | 10,899 | 43 | 11¼ | 34 | Hyd |
| 101 | 8¾ | HTC | W7R | 11 | | 10,903 | 4 | 3¼ | 40 | Conv |
| 102 | 8¾ | HTC | R-I | 11 | | 10,946 | 43 | 14 | 40 | Conv |
| 103 | 8¾ | HTC | R-I | 11 | | 10,967 | 27 | 11¼ | 40 | Hyd |
| 104 | 8¾ | Solid | | 5/16x3/16 | | 10,980 | 13 | 11¼ | 14 | Conv |
| 105 | 8¾ | HTC | R-I | 11 | | 11,010 | 30 | 9½ | 40 | Hyd |
| 106 | 8¾ | HTC | W7RJ | 5/16 | | 11,066 | 56 | 15 | 40 | Hyd |
| 107 | 8¾ | HTC | W7RJ | 5/16 | | 11,132 | 66 | 13¾ | 40 | Hyd |
| 108 | 8¾ | HTC | W7RJ | 5/16 | | 11,192 | 60 | 14 | 40 | Hyd |
| 109 | 8¾ | HTC | W7RJ | 5/16 | | 11,256 | 64 | 14½ | 50 | Conv |
| 110 | 8¾ | HTC | W7RJ | 5/16 | | 11,268 | 12 | 5½ | 40 | Hyd |
| 111 | 8¾ | HTC | W7R | 11 | | 11,294 | 26 | 10¾ | 50 | Hyd |
| 112 | 8¾ | HTC | W7RJ | 5/16 | | 11,324 | 30 | 10¾ | 50 | Conv |
| 113 | 8¾ | HTC | R-I-J | 12 | | 11,429 | 105 | 18½ | 40 | Conv |
| 114 | 8¾ | HTC | W7RJ | 5/16 | | 11,468 | 39 | 6¾ | 50 | Conv |
| 115 | 8¾ | HTC | W7RJ | 5/16 | | 11,487 | 19 | 7¼ | 50 | Conv |

**TABLE 8**
**Well B**

| Run No. | Size | Make | Type | Jet Size | DEPTH From | To | Feet | Hours | Weight On Bit | |
|---|---|---|---|---|---|---|---|---|---|---|
| 79 | 8⅝ | HTC | R-1 | | 10,059 | 10,115 | 56 | 20 | 45 | Conv |
| 80 | 8⅝ | HTC | R-1 | | | 10,154 | 39 | 16½ | 45 | Conv |
| 81 | 8⅝ | Dia | Dia | | | 10,197 | 43 | 17 | 12 | Conv |
| 82 | 8⅝ | HTC | R-1 | 11 | | 10,238 | 41 | 20¾ | 30 | Conv |
| 83 | 8⅝ | HTC | R-1 | 11 | | 10,271 | 33 | 18½ | 30 | Conv |
| 84 | 8⅝ | HTC | R-I-J | 5/16 | | 10,349 | 78 | 19¾ | 40 | Hyd |
| 85 | 8⅝ | HTC | R-I-J | 5/16 | | 10,434 | 85 | 22¾ | 35 | Hyd |
| 86 | 8⅝ | HTC | R-I-J | 5/16 | | 10,491 | 57 | 19 | 35 | Hyd |
| 87 | 8⅝ | HTC | R-I-J | 5/16 | | 10,544 | 53 | 15¼ | 35 | Hyd |
| 88 | 8⅝ | HTC | R-I-J | 5/16 | | 10,596 | 52 | 77 | 35 | Hyd |
| 89 | 8⅝ | HTC | R-I-J | 5/16 | | 10,608 | 12 | 6½ | 40 | Hyd |
| RR81 | 8⅝ | Dia | Dia | | | 10,612 | 4 | 5¼ | 15 | Conv |
| 90 | 8⅝ | HTC | R-I-J | 5/16 | | 10,658 | 46 | 15 | 35 | Hyd |
| 91 | 8⅝ | HTC | R-I-J | 5/16 | | 10,668 | 10 | 4½ | 35 | Hyd |
| 92 | 8⅝ | HTC | R-I-J | 5/16 | | 10,717 | 49 | 13¼ | 35 | Hyd |
| 93 | 8⅝ | HTC | R-I | | | 10,731 | 14 | 6¾ | 35 | Hyd |
| 94 | 8⅝ | HTC | W7R-J | 5/16 | | 10,792 | 61 | 15 | 35 | Hyd |
| 95 | 8⅝ | HTC | W7R-J | 5/16 | | 10,824 | 32 | 9 | | Hyd |
| 96 | 8⅝ | HTC | W7R-J | 5/16 | | 10,870 | 46 | 9¾ | | Hyd |
| 97 | 8⅝ | HTC | W7R-J | 5/16 | | 10,903 | 33 | 8¼ | 40 | Hyd |
| 98 | 8⅝ | HTC | W7R-J | 5/16 | | 10,906 | 3 | 5¼ | 40 | Hyd |
| RR93 | 8⅝ | HTC | R-I | | | 10,924 | 18 | 11½ | 40 | Hyd |
| 99 | 8⅝ | HTC | R-I | 5/16 | | 11,048 | 124 | 27¼ | 40 | Hyd |
| 100 | 8⅝ | HTC | W7R-J | 5/16 | | 11,152 | 104 | 15 | 40 | Hyd |
| 101 | 8⅝ | HTC | W7R-J | 5/16 | | 11,318 | 159 | 17¼ | 40 | Hyd |
| 102 | 8⅝ | HTC | W7R | | | 11,415 | 97 | 13 | 40 | Hyd |
| 103 | 8⅝ | HTC | W7R | | | 11,454 | 39 | 11½ | 40 | Hyd |

**TABLE 9**
**Well C**

| No. | Size | Make | Type | Jet | Depth Out | Feet | Hours | Weight On Bit |
|---|---|---|---|---|---|---|---|---|
| 118 | 8¾ | HTCo | WTR | 11″ | 10,890 | 29 | 10¼ | 35/40 |
| 119 | 8¾ | HTCo | WTR | DWC | 10,913 | 23 | 10 | 40 |
| 120 | 8¾ | HTCo | WTR | DWC | 10,935 | 22 | 9¼ | 45 |
| 121 | 8¾ | HTCo | WTR | DWC | 10,966 | 31 | 9¼ | 45 |
| 122 | 8¾ | HTCo | WTR | DWC | 11,045 | 79 | 15½ | 40 |
| 123 | 8¾ | HTCo | W7RJ | 12″ | 11,135 | 90 | 17 | 40 |
| 124 | 8¾ | HTCo | W7RJ | 12″ | 11 253 | 118 | 15 | 40 |
| 125 | 8¾ | HTCo | W7RJ | 12″ | 11,327 | 74 | 12¾ | 42 |
| 126 | 8¾ | HTCo | W7R | 11″ | 11,373 | 46 | 8½ | 40 |
| 127 | 8¾ | HTCo | W7R | 11″ | 11,428 | 55 | 7½ | 42 |
| 128 | 8¾ | HTCo | W7R | 11″ | 11,452 | 24 | 9¼ | 40 |
| 129 | 2 | HTCo | W7R | 11″ | 11,481 | 29 | 9½ | 42 |

Drilling in the Delaware Basin shows . . .

# New Depths Reached With Natural Gas

**A 66 percent reduction in drilling costs was obtained below 8000 feet; lost circulation was controlled, penetration rates increased, by use of gas for drilling.**

By **W. W. DALLAS,** Drilling Superintendent, and **E. J. COEL, JR.,** Senior Petroleum Engineer, El Paso Natural Gas Company, Farmington, New Mexico

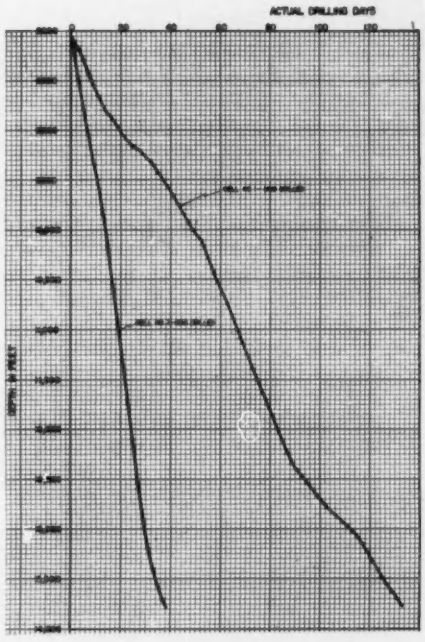

**FIGURE 1—Graph of the actual drilling time for the gas drilled Poker Lake 2 vs. the conventionally mud drilled Poker Lake 1.**

WHAT IS BELIEVED to be a new depth record using natural gas as a circulating medium was established by El Paso Natural Gas Company upon abandonment of their Poker Lake Unit No. 2 well in the Delaware Basin. Nine and five-eighths-inch OD casing was set at 8077 feet in a mud filled hole. An 8⅝ inch hole was gas drilled to 13,792 feet where a fishing job stopped drilling only 39 days later. This accomplishment saved almost 140 days rig time, 114 bits, nearly six days of lost circulation, and many thousands of dollars worth of drilling mud.

The Poker Lake Unit No. 2 in Section 1, Township 25 South, Range 30 East, Eddy County, New Mexico, was planned as a wildcat test of the Wolfcamp formation. The well was spudded May 20, 1955, by Great Western Drilling Company of Midland, Texas and was temporarily abandoned August 31, 1955. During these 100 days, three strings of casing were set, three changes in mud program were made, two drill stem tests were run, two fishing jobs occurred, and the well was drilled to a total depth of nearly 14,000 feet.

An offset well (No. 1) approximately 1½ miles away from the Poker Lake Unit No. 2 afforded an excellent study of the formations to be encountered and the type of drilling problems to be expected. No. 1 well records indicated that gas drilling might save considerable time and money, prevent lost circulation problems, and give an easier and more complete method of testing possible pay zones to 12,500 feet. After the expected total depth had been reached without commercial shows, El Paso elected to carry the well to 15,000 feet, if such could be done by gas drilling.

A four-string casing program was selected: (1) surface casing, (2) salt string, (3) intermediate casing and (4) a production liner if needed. Gas drilling was not to commence until the intermediate casing was set at the base of the Delaware Group of the Permian section. This was the lowest known depth where large flows of water could be expected which would prevent gas drilling.

Surface casing of 20-inch OD 78.6 pound line pipe was set and cemented with 1000 sacks of cement at 618 feet in the Permian Red Beds. A high viscosity fresh water mud was used to combat excessive loose sand entry into the well bore. Total time for drilling, reaming and setting surface casing was four days.

The salt string consisted of 13⅜-inch OD casing of 54.5 pound, 68 pound annd 72 pound, J-55 and N-80 cemented at 4097 feet. A two-stage procedure using 4400 sacks of cement was employed. Twelve 17½-inch bits were used. The drilling mud was salt base. Twenty days were consumed by drilling and setting casing through the Evaporite Section of the Permian.

The intermediate string was cemented by the two-stage method using 1350 sacks of cement. A total of 8077 feet of 9⅝-inch OD, 43.5 pound and 40 pound, S-95 and S-80, respectively, made up this protective casing. Three lost circulation zones were found while drilling from 4097 feet to 8077 feet. The diesel oil base mud used salt inhibitor and was loaded with lost circulation materials. Twenty 12¼-inch bits were used to drill this section in 26 days.

The well history from the No. 1 showed that high pressures (nearly 7000 psi) might be found at the proposed total depth. Therefore, certain precautions were necessary before drilling into the section. A 2900 series christmas tree was selected. This was later changed to a 1500 series head to accommodate the 8⅝-inch bits to be used. A 10-inch rubber pack-off rotating head with a 7-inch outlet was mounted on a 10-inch double rammed hydraulically operated blowout preventer. This was flanged to the upper casing spool of the christmas tree. A kill line from the now idle rig pump was connected to the blowout preventer. Kill lines from the christmas tree were strung away from the rig so that truck-mounted pumps could be used, if necessary. The mud supply house was placed on one hour notice for proper weight material and gel that would be used if an encountered gas flow grew too dangerous for drilling or tripping the drill pipe.

Drilling gas available from El Paso's mainline system, only three-fourths of a mile distant, was used. This supply was maintained at an average of 300 psi at the stand pipe with an average flow volume rate of 3½ MMcf/d. The gas was circulated in a conventional manner, down the drill pipe, up the annulus, and out the 7-inch flow line

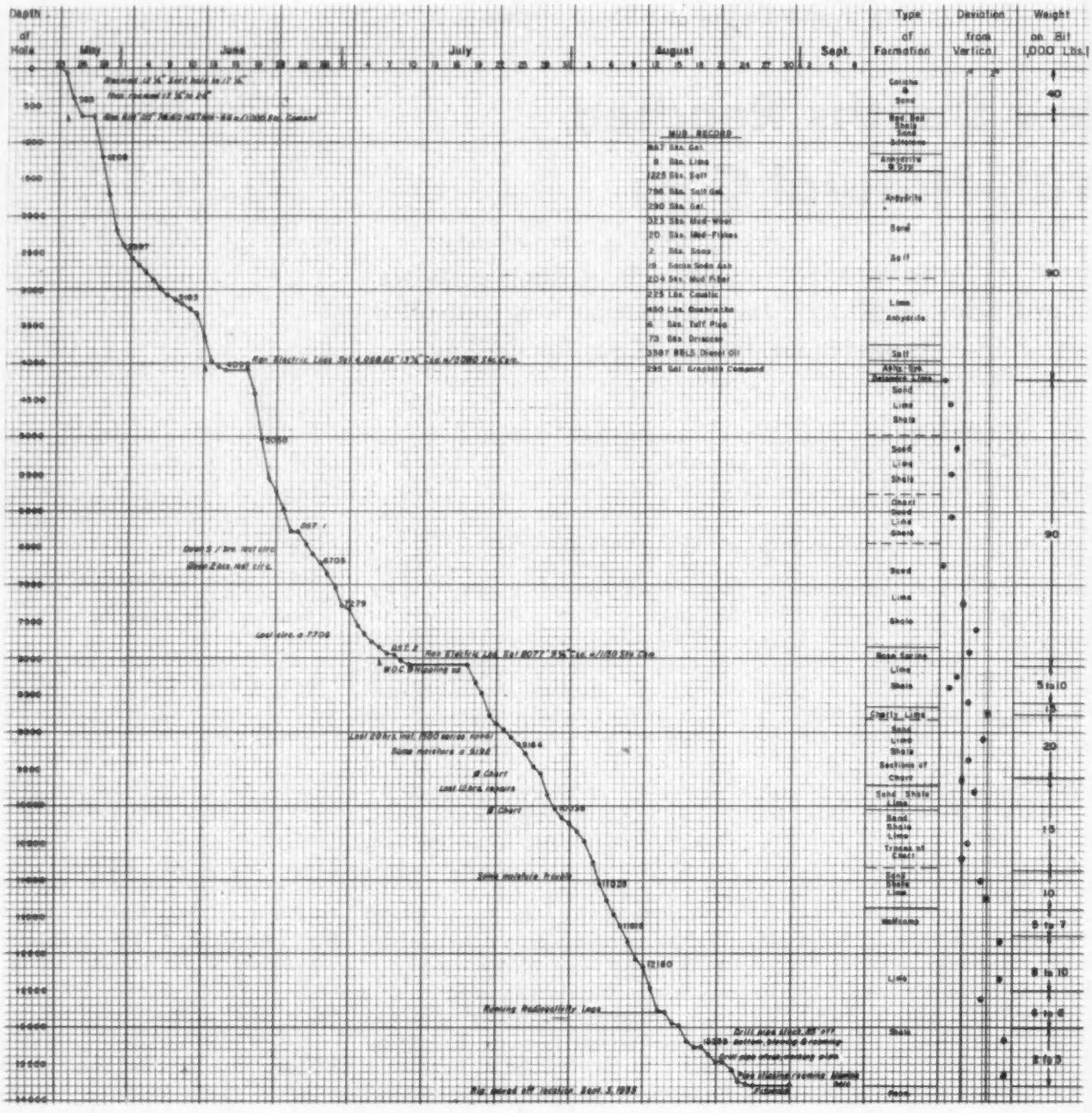


FIGURE 2—Drilling log of the gas drilled Poker Lake 2.

on the rotating head. The drilling gas was flared as an extra precaution against gathering fumes.

The drill stem consisted of 4½-inch OD Grade E, 16.60 pound bottle necked pipe and six 7-inch OD drill collars. Rubber type stabilizers were placed 60 feet above the bit. Thirty hard rock, tri-cone, conventional bits were used to drill the gas hole. Bit life ran from a maximum of 447 feet to a minimum of 16 feet, an over-all average of 180 feet per bit. Weight on the bit varied from 18,000 pounds to a minimum of 2000 pounds. The usual average was from 4000 to 6000 pounds.

At no time did the hole deviate more than 2¾ degrees from the vertical despite the average drilling rate of 165 feet per day, and the encountering of alternating hard cherts and soft sands sections. Chert sections cut bit life by nearly 95 percent. The soft formations necessitated, in some cases, constant circulation of drilling gas for nearly 24 hours to clear the bore hole of cuttings before drilling could be continued.

At 9200 feet a slight non-commercial oil seep was penetrated. This liquid entry was to cause more trouble at greater depths. The original total depth (12,500 feet) was reached in 26 days of gas drilling without worthwhile gas or oil discoveries. At this point, El Paso Natural Gas elected to drill to 15,000 feet, if possible. A great saving of drilling cost already had been effected and the situation allowed the possibility of exploring a greater depth without a large extra cost per foot.

The 16.60 pound drill pipe was continued in use, and 20 pound, 4½-inch, Grade E pipe was added as drilling progressed deeper. Without mud in the hole to lend the customary buoyancy, weight of the 16.60 pound drill pipe was nearing the safety factor

*Continued on Page 122*

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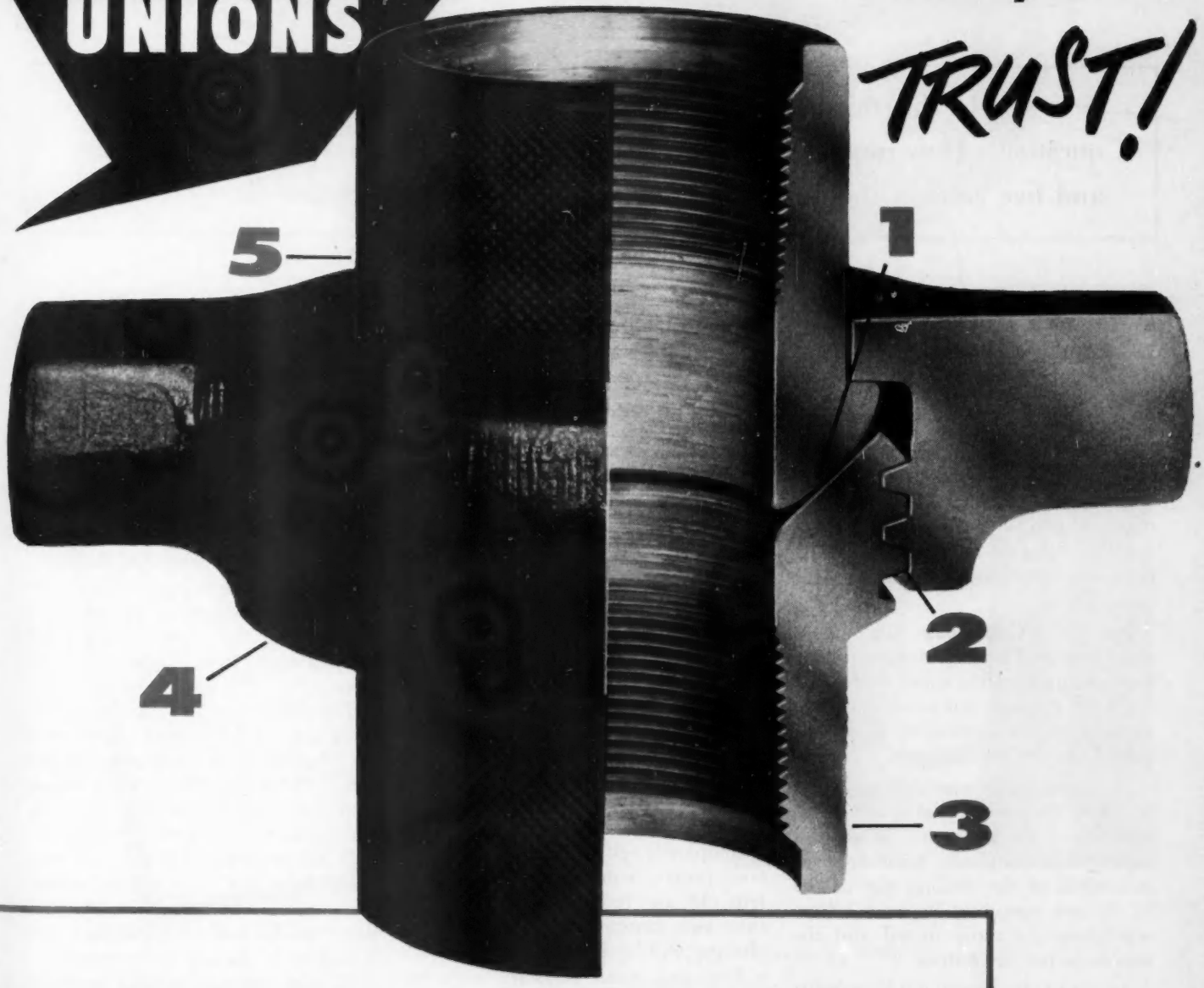


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# When Does It Pay to Drill With Air?

**In this third and concluding article on air drilling, the all-important question—How much?—is answered. Here are three typical drilling problems and five rules-of-thumb that will help you decide when to use air.**

**By JAMES T. MORRIS,** Morris and Company, Houston
and **ROBERT P. RAMSEY,** The Cooper-Bessemer Corporation, Mt. Vernon, Ohio

In Pennsylvania, it is possible in some areas to use air as a circulating medium from grass roots to over 7000 feet. Penetration rates are doubled in many instances and overall drilling costs are reduced by 25 percent. The economic advantages of using air are clear-cut.

Along the Gulf Coast, just the reverse is true. The soft formations, the frequent and prolific water zones, and the high pressure gas sands combine to make the economical use of air impossible at the present time.

If all rotary rigs were drilling in one of these two areas, the question of whether to use air would be easy to answer. Unfortunately, however, over two-thirds of the drilling rigs in the U. S. are operating in areas where conditions are more mixed and the answer is not so obvious.

In most fields, it will not be possible to use air or air-mud drilling continuously. The contractor will have to resort to mud for an important part of the footage. This will limit the benefits that can be derived from the use of air. On the other hand, competitive pressure makes it necessary to consider anything that might reduce total drilling costs. Since air can substantially increase penetration rates, there is a possibility that it might reduce drilling costs even if it is used for a comparatively small part of the footage.

In most of the wells drilled in the U. S., the question of whether air should be used is not easily answered. It can only be answered by comparing the added costs of air drilling with the added saving in each case, and then seeing whether the net result is likely to be a decrease or an increase in total drilling costs.

## COSTS THAT ARE INCREASED WHEN AIR DRILLING IS USED

1. *DAILY RIG COSTS. Whether air compressors are rented or purchased, they will add to daily costs. Just how much depends largely on whether a service company is employed or whether compressors are rented or purchased.*

### Costs if Service Company Is Used

One service company charges $350 per day base rate for an operator with a completely self-contained, self-powered trailer-mounted compressor system. If air requirements are such that two compressors are required, charges will be $500 per day.

Fuel and repair costs are borne by the service company. Transportation and travel time may or may not be charged to the contractor, depending on details of the agreement. A minimum charge of a certain number of days is usually charged, depending on location and other factors. Service companies supply skilled advisers to help the drilling contractor take full advantage of the use of air as a drilling medium.

While service company charges may seem high in comparison with other means of providing air compressors, it is well to remember that all the charges are visible. All charges, fuel, repairs and transportation, as well as depreciation or rental, must be added together in the event of rented or purchased compressors before a fair comparison can be made.

**Part 3**

### Costs if Compressors Are Rented

Rental practices vary with location, type of equipment supplied, and other factors. In many areas, suitable equipment is not available at any price.

The most common type of compressor available for rental purposes is the wheel-mounted, self-powered, 600 cfm, 120-150 psi compressors widely used for construction and demolishing work. One reported rental rate is $1500 per month. If three of these compressors are required on a well, the monthly charge will be $4500. If they can be used continuously, and if it takes 30 days or more to drill the well, the savings would probably make the cost small by comparison.

Rental charges *do not* normally include transportation to and from location, fuel, and the cost of maintenance and repairs while on location. In the case of rental equipment that has been designed for other purposes, it may also be necessary to allow funds for additional equipment, such as aftercoolers, that may be necessary to build up a system suitable for air drilling. This cost should not be high in comparison to the rental cost of the compressors themselves.

### Cost if Compressors Are Purchased

A bare compressor unit of the high-speed piston type may cost less than $40 per horsepower, but such a unit would certainly not be suitable

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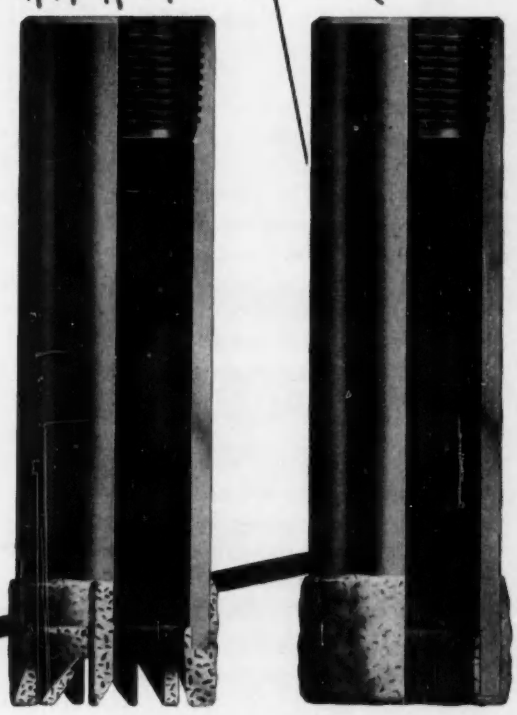
# KLUSTRITE

## Case History

1. Harvey, Louisiana—Two **HOMCO "Klustrite" Rotary Shoes**—36 hours—burned up 1 regular type rotary shoe, a piece of a box tap, part of a die nipple, a four-foot slab of 10¾" casing, 4 sets of cutter knives—and an additional 10 feet of hole was made. Hole cleaned—drilling operations resumed.

2. White Castle, Louisiana—Using a 9¼" cutting type **HOMCO "Klustrite" Rotary Shoe,** 6340 feet of hole was drilled through tight formations and anhydrite; total drilling time, 5 days.



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for air drilling, and, it would have to be packaged into a suitable system.

The cost of this packaging may vary widely, depending on the pressures required, the degree of automatic control needed, the type of drive used, foundation requirements, etc. One company reported purchasing a high pressure, skid-mounted, rig-powered compressor system at a cost of approximately $100 per horsepower. For a 300 horsepower unit, this would mean an investment of about $30,000. Multi-stage compressor systems, suitable for aerated mud drilling, will cost more than simple two stage systems because of the extra intercoolers and controls that are required.

If sufficient rig power is not available, the system must include an engine. This will further increase both cost and weight. Self-powered packaged compressor systems suitable for air drilling could be expected to range from less than one hundred dollars per horsepower to over 150 dollars per horsepower.

### Effect of Purchased Compressors on Daily Rig Costs

In order to judge how much depreciation to charge per operating day, accepted drilling contractor cost accounting methods may be used.

In order to use these methods, it is first necessary to arrive at a reasonable life expectancy. Since there is limited field experience upon which to base a judgment, some difficulty might be expected.

For the purpose of this discussion, however, the depreciation life shall be assumed to be 1500 days. Some authorities will contend that, since air cannot be used all of the time, 500 or 800 days might be a better figure. Others contend that a heavy duty compressor system should last almost indefinitely, so a longer depreciation period should be allowed.

The simple, straight line method of depreciation will be selected. In actual practice the unit use method of depreciation would have some advantages, but since the straight line method is simple, it will be used for illustration.

For example, if a compressor system costs $30,000, the daily depreciation charge would be 30,000 divided by 1500 or 20 dollars per day.

However, it also is necessary to allow for added overhead, insurance and taxes, as well as interest on the investment. When all these items are added, the daily cost rises to between 30 and 40 dollars per day, *provided the compressor can be used every day on every well.*

From these representative costs, it appears that a purchased compressor system will result in the smallest addition to daily rig costs. This is true at current rates *if air can be used a sufficient percentage of the time,* but in many areas it may be expedient and more economical to rent compressors or employ service companies.

Many authorities think that a suitable air compressor system will add from 3 to 10 percent to daily rig costs. Much field experience is needed, however, before this figure can be confirmed or revised.

2. *MOVING COSTS AND RIG-UP COSTS: The compressor system used in the preceding example would weight around 35,000 pounds and would add between 5 and 10 percent to moving costs. If a move would cost $3000 without an air compressor, it might cost about $3200 with compressor.*

Likewise, the air system will add to the cost of rigging up. At the present time, there hasn't been sufficient experience to give an accurate idea of the additional cost, but a review of the equipment involved would indicate that the rigging up time should not be increased by more than 10 percent.

3. *MISCELLANEOUS EQUIPMENT COSTS: The rotating head, additional manifolding, valves, and other equipment needed when drilling with air will add slightly to the weight and initial cost of the rig. The only item of miscellaneous equipment that will have much effect on daily rig costs is replacement rubbers for the rotating head. One authority has estimated that an allowance of around $20 per day might take care of this item in the case of air drilling.*

With air-mud drilling, the problem is somewhat different. One operator uses a specially designed packoff that uses pipe wipers as baffles. Replacement costs are very low in this instance.

### COSTS THAT ARE REDUCED WHEN DRILLING WITH AIR

1. *SLUSH PUMP MAINTENANCE COSTS: Since slush pumps are either not running (when air drilling) or running far below capacity (when air-mud drilling), slush pump maintenance costs are greatly reduced.*

The saving from slush pump repairs depends on such things as pump pressure, sand content of mud, etc., but some contractors will allow 15 to 25 dollars per day for slush pump repairs. All these costs cannot be classed as savings, however, since the air compressor will require some maintenance.

The maintenance costs on a modern heavy duty air compressor system suitable for air drilling should be negligible as compared to the maintenance on a slush pump. Since air compressors can handle clean air rather than drilling mud, and since compressor parts may be effectively lubricated, compressor parts will last many times as long as the corresponding slush pump parts.

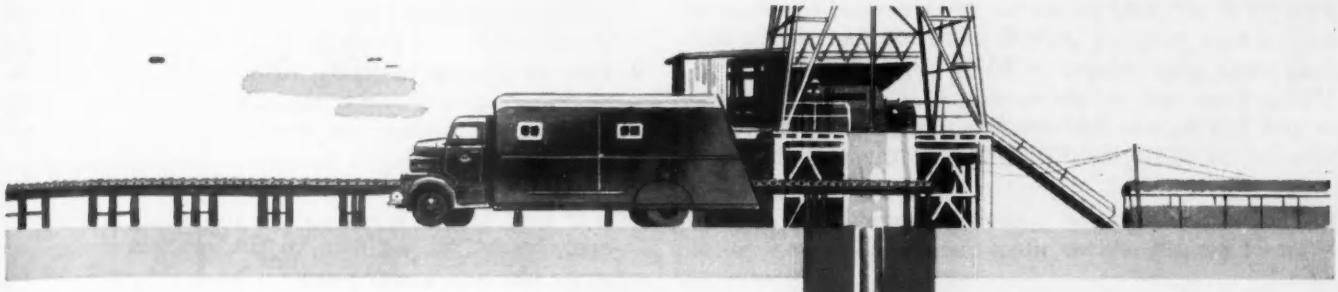
Of course, maintenance costs cannot be eliminated, but they might be reduced to $5 per day rather than $20.

2. *WATER AND MUD COSTS: In some areas where water must be hauled for miles, water costs may run*

| | |
|---|---|
| **RIG DATA:** | |
| Size and type | 700 hp Jackknife |
| Approximate weight of rig | 800,000 pounds |
| Number of loads | 22 |
| Approximate cost of rig including drill string | $300,000 |
| Average rig-up time | 2½ days |
| **AIR COMPRESSOR DATA:** | |
| Weight of compressor system | 38,000 pounds |
| Number of loads | One |
| Added cost of compressor system | $35,000 |
| Rig-up time (with compressor) | 2¾ days |

**DAILY RIG COSTS**

| Item | Mud Drilling Without Air Compressor | Mud Drilling With Air Compressor | Air Drilling |
|---|---|---|---|
| Rig Depreciation | $ 200 | $ 235 | $ 235 |
| Drill String Depreciation | 60 | 60 | 60 |
| Overhead | 160 | 160 | 160 |
| Labor and Supervision | 300 | 300 | 300 |
| Repairs & Supplies | 135 | 135 | 125 |
| Fuel | 85 | 85 | 85 |
| | $ 940 | $ 975 | $ 965 |



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*from 15 to 40 cents per barrel. With normal evaporation and seepage losses on a 7000 to 10,000 foot well, water costs alone may amount to $5000 per well, or more.*

Mud costs vary so widely that it is almost impossible to give any figures that would apply generaly. For purposes of discussion, mud costs may be divided into three parts:

1. **The original volume needed for mud drilling:** The use of air will seldom affect this cost, because in most cases, it will be necessary to resort to the use of mud for at least part of the hole.
2. **Lost circulation material** requirements can be drastically reduced through the use of air, particularly if a higher pressure compressor system suitable for aerated mud drilling is used. It is frequently possible to use air rather than lost circulation material.

   It may be possible to avoid using lost circulation materials by drilling with air through lost circulation zones and until a casing string is set.

   If this is not possible, it may be possible to inject air into the mud stream to reduce down-hole pressure.
3. **Make-up mud** to replace that lost to formation can be expensive, particularly in the case of severe lost circulation problems. The amount of mud required for this purpose can be greatly reduced by using air drilling.

While it is not usually possible to avoid mud costs completely, it is possible to greatly reduce mud costs by using air. On some wells, lost circulation may cost nearly $100,000. In such a case, the savings on a single

*Text Continued on Page 120*
*Example 2 on Page 119*

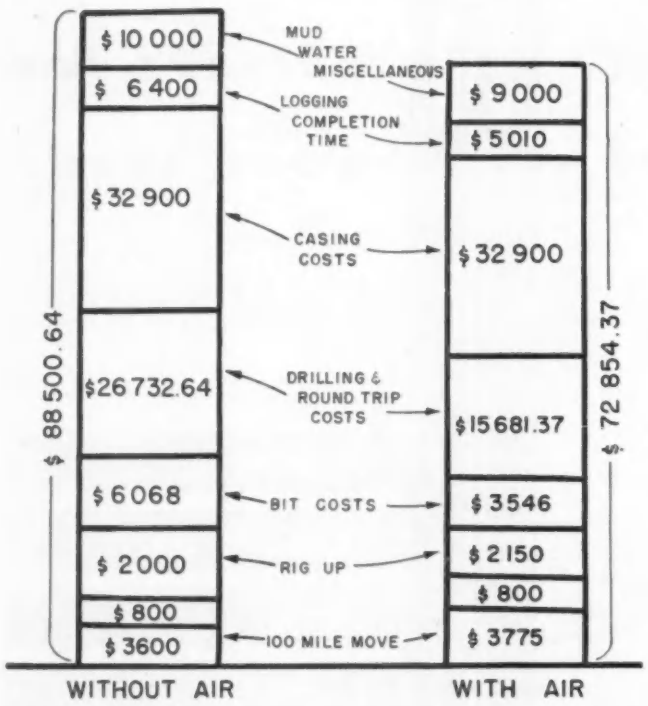


**FIGURE 4—Use of air permits substantial saving in this case even though two water zones are encountered. Zones are located so they can be cased off quickly without using an extra string. As a result, air can be used for bulk of the footage with resultant savings in bit costs and drilling**

## Example 1

**Well Data:**

| | |
|---|---|
| Type of well | Field development |
| Depth of field | 6000 feet |
| Average drilling time | 29 days |
| Average number of bits | 28 |
| Average number of days to log and complete | 8 |
| Water sands | 520—590 feet<br>2940—2970 feet |

**Casing Program:**

| | |
|---|---|
| Surface string | 10¾ inches to 650 feet |
| Intermediate string | 8⅝ inches to 3700 feet |
| Oil string | 5½ inches to TD |

**Question:**

Can air be used profitably to drill this well, assuming a 100 mile move?

To find an answer, the cost of the well will be estimated roughly both with and without air.

For purposes of this calculation, it shall be assumed that air will be used from surface to 525 feet, from 650 to 2950 feet and from 3700 feet to 6000 feet. Mud will be used from 525 feet to 650 feet, and from 2950 feet to 3700 feet.

It shall be assumed that air drilling rates will average 40 feet per hour for the surface hole. 30 feet per hour for between 690 and 3700 feet, and 15 feet per hour between 3700 feet and 6000 feet. It shall also be assumed that average penetration rates with mud will be half those with air. The number of hours per bit shall be assumed to be 20 hours in either case.

Since it will be possible to drill into the formation using air, a saving of two days in logging and completion will be assumed.

**COST ESTIMATE**

| Item | Without Air | With Air |
|---|---|---|
| 100-mile move | $ 3600 | $ 3775 |
| Site preparation | 800 | 800 |
| Rig-up | 2000 | 2150 |
| **Surface Hole:** | | |
| Bit Costs 13¾": | | |
| 2 Bits | 660 | |
| 1 Bit | | 330 |
| Drilling Time: | | |
| 32½ Hours @ $940/Day | 1272.94 | |
| 19½ Hours @ $965/Day | | 783 |
| Surface casing Total | 3100 | 3100 |
| **Protective Hole:** | | |
| **(650-3700 feet)** | | |
| Bit Costs 10⅝" @ $256: | | |
| 10 Bits | 2560 | |
| 7 Bits | | 1792 |
| Drilling and Round-trip Costs: | | |
| 200 hours drilling time plus 40 hours round trip time equals 10 days @ $940/Day | 9400 | |
| 80 hours @ $965/Day plus 50 hours @ $975/Day, plus 30 hours round-trip time @ $965/Day | | 6454.07 |
| Protective Casing | 14,800 | 14,800 |
| **Hole to Pay (3700-6000 feet)** | | |
| Bit Costs 7⅞" @ $178: | | |
| 16 Bits | 2848 | |
| 8 Bits | | 1424 |
| Drilling and Round-trip Costs: | | |
| 305 hours drilling time, plus 105 hours round-trip time equals 410 hours @ $940/Day | 16,059.70 | |
| 154 hours drilling time, plus 56 hours round-trip time equals 210 hours @ $965/Day | | 8443.40 |
| Oil String Costs—Total | 15,000 | 15,000 |
| Logging & Completion time: | | |
| 8 Days @ $800/Day | 6400 | |
| 6 Days @ 835/Day | | 5010 |
| Mud, Water & Miscellaneous | 10,000 | 9000 |
| TOTAL | $88,500.64 | $72,854.47 |

These figures indicate a saving of about 18 percent if the contractor has his own rig-powered compressor system. Even if he does not own a compressor system, the savings would be large enough to justify renting compressors or employing an air drilling service company.

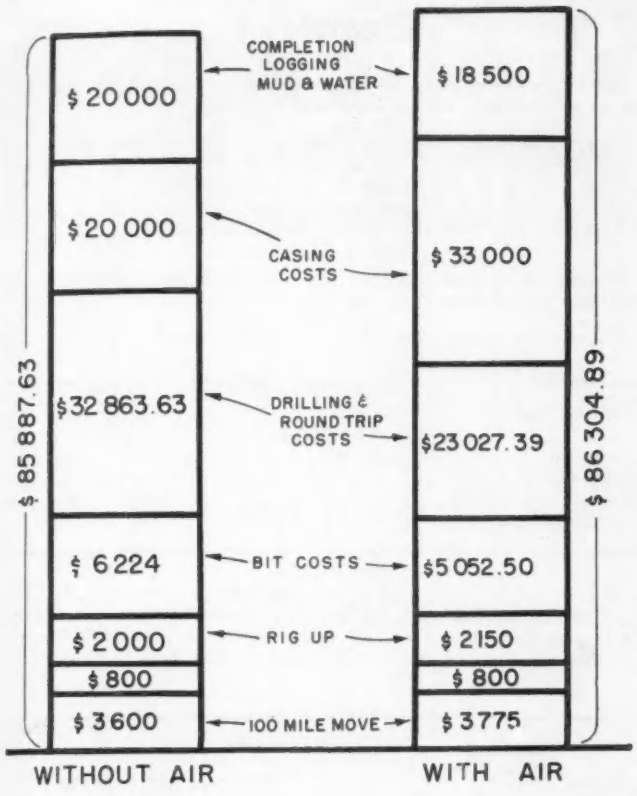


**FIGURE 5—Five inconveniently placed water zones limited the percentage of time air could be used and made an intermediate casing string necessary. Savings that might otherwise have been realized have been cancelled out by casing costs.**

## Example 2

**Well Data:**

| | |
|---|---|
| Type of Well | Field Development |
| Depth of Field | 6000 feet |
| Average Drilling Time | 36 Days |
| Average Number of Bits | 33 |
| Average Number of Days to Log and Complete | 8 |
| Water Sands: | 295— 350 feet |
| | 1160—1240 feet |
| | 2090—2230 feet |
| | 3090—3250 feet |
| | 5300—5320 feet |

**Casing Program:**

| | Mud | Air |
|---|---|---|
| Water String | 9⅝ inches to 1300 feet | 11¾ inches to 1300 feet |
| Intermediate String | None | 9⅝ inches to 3400 feet |
| Oil String | 7 inches to 6000 feet | 7 inches to 6000 feet |

| Depth | Mud | Air |
|---|---|---|
| 0—1300 | 60 feet per hour | 80 feet per hour |
| 1300—3400 | 20 feet per hour | 30 feet per hour |
| 3400—6000 | 5 feet per hour | 10 feet per hour |

Bits shall be assumed to drill for 20 hours.

Since it will not be practical to drill into the producing formation using air, no savings in logging and completion time will be assumed.

Daily rig costs shall be assumed to be the same as in example number one.

**COST ESTIMATE**

| Item | Without Air | With Air |
|---|---|---|
| 100-mile move | $ 3600 | $ 3775 |
| Site preparation | 800 | 800 |
| Rig-up | 2000 | 2150 |
| Surface Hole: | | |
| Bit Costs: | | |
| 1—12¼″ Bit | 304.00 | |
| 1—15″ Bit | | 415.00 |
| Drilling Time Charge: | | |
| 22 hours @ $940/Day | 861.74 | |
| 19½ hours @ $965/Day | | 783.00 |
| Casing String | 5000.00 | 6000.00 |
| 1300 to 6000 feet (mud drilling only) | | |
| Bit Costs:—8¾″ | | |
| 32 Bits @ $197.50 | 6320.00 | |
| Drilling and Round-trip time costs: | | |
| 625 hours drilling plus 192 hours round trip @ $940/Day | 32,001.89 | |
| Oil String | 15,000.00 | |
| Intermediate String (for air drilled well only): | | |
| 1300 to 2100 feet (air) and 2100 to 3400 (mud) | | |
| Bit Costs:—11″ | | |
| 5 Bits @ 256 | | 1280.00 |
| Drilling and Round-trip time costs: | | |
| 24 hours @ $965/Day plus 65 hours @ $975/Day plus 30 hours round-trip time @ $965/Day | | 4816.31 |
| Intermediate casing string | | 12,000.00 |
| Hole to pay (3400 to 6000 feet) | | |
| 3400 to 5300 feet with air and 5300 to 6000 feet with mud: | | |
| Bit Costs:—8¾″ | | |
| 17 Bits @ $197.50 | | 3357.50 |
| Drilling and Round-trip time costs: | | |
| 190 hours @ $965/Day plus 140 hours @ $975/Day plus 102 hours round-trip time @ $965/Day | | 17,428.08 |
| Oil String | | 15,000.00 |
| Completion, logging, mud and water costs | 20,000.00 | 18,500.00 |
| TOTAL | $85,887.63 | $86,304.89 |

**Question:**

Can air be used profitably to drill this well, assuming a 100-mile move?

In order to answer the question, the cost of the well will be estimated roughly both with and without air.

For purposes of this calculation, it shall be assumed that air shall be used from surface to 295 feet, from 1300 feet to 1725 feet and from 3400 to 5300 feet. Mud will be used for the other intervals.

It shall also be assumed that drilling rates will average as follows:

This example is clearly a borderline case that might turn either way in actual practice. A single lost circulation zone could easily shift the balance clearly in favor of air.

Conversely if one of the water zones is encountered too soon, or the 3070 foot water zone was just a little deeper, it would probably be desirable to complete the well with mud and avoid setting the extra casing string.

If a contractor already had a compressor system, he might try drilling with air, but rental is clearly not advised in this case.

To illustrate just how heavily the balance can shift, a third example will be calculated.

well could more than pay for a complete air compressor system.

On the average, water and mud savings will be much more modest and will depend entirely on well conditions. It seems entirely reasonable to expect savings of at least 20 percent in mud and water costs.

3. *BIT COSTS are generally reduced in an important manner when air is used as a circulating medium. It is not uncommon to have bit requirements cut in half during the time air is being used. Just how much saving may be realized depends entirely on what percentage of the time air can be used.*

If air could be used for half of a well, and if it cut bit requirements by 25 percent, savings of $2000 on bit costs alone would be possible in some instances.

It is not easy to determine in advance whether the use of air can save money on a particular well, particularly if that well is a wildcat. However, it is possible (if subsurface conditions are generally known) to see whether the use of air would be a good bet.

In order to point out how this might be done, three hypothetical examples will be given, calculations will be made and preliminary conclusions will be drawn. In all of these examples, the same rig will be used, so rig rates will be the same in every case.

*Text Continued on Page 122*

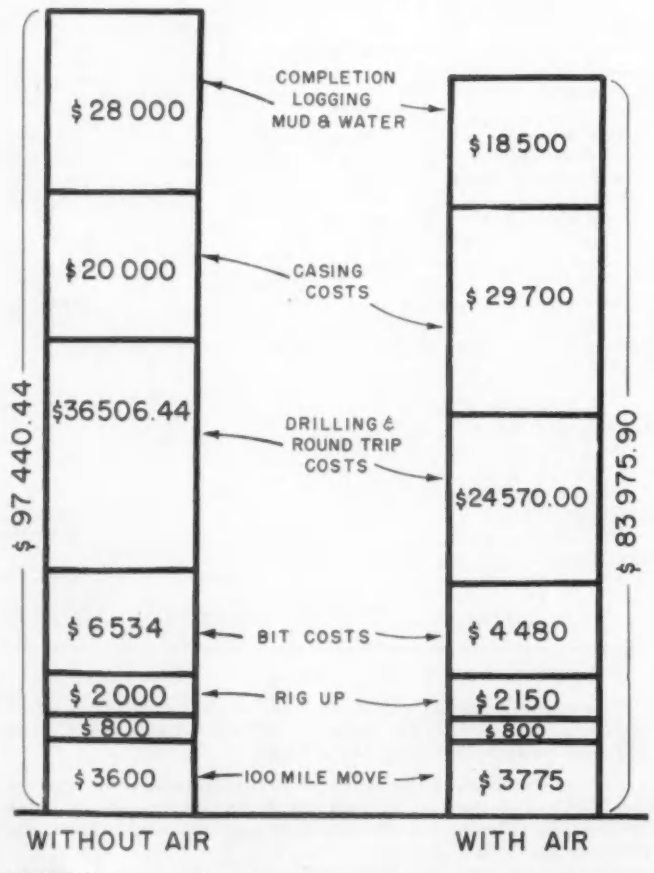


**FIGURE 6—Same number of water zones were encountered as in Figure 5, but they are more favorably placed. An extra casing string is used, but it is smaller. The thick hard section also increases savings. Result would be an important saving even if the lost circulation problem were not encountered.**

## Example 3

In this example, most items are the same as those given in example number two except for three changes:

First: The locations of the water sands are changed to:

595 to 650 feet
1160 to 1240 feet
2290 to 2430 feet
2770 to 2850 feet
5300 to 5320 feet

Second: It is assumed that the hard formations will start at 2900 feet rather than 3400 feet.

Third: The casing program is changed to the following:

**Casing Program:**

| | Mud | Air |
|---|---|---|
| Water String | 9⅝" to 1300 feet | 10¾" to 1300 feet |
| Intermediate String | ..... | 8⅝" to 2900 feet |
| Oil String | 5½" to TD | 5½" to TD |

It is assumed that a lost circulation zone is encountered in the mud drilled well and $8,000 is spent to combat lost circulation. In the case of the air drilled well, lost circulation problems are avoided through the use of air to lighten the fluid column.

**COST ESTIMATE**

| Item | Without Air | With Air |
|---|---|---|
| 100-mile move | $ 3600 | $ 3775 |
| Site preparation | 800 | 800 |
| Rig-up | 2000 | 2150 |
| Surface Hole: | | |
| Bit Costs: | | |
| 1—12¼" Bit | 304 | |
| 1—13¾" Bit | | 330 |
| Drilling Time Charge: | | |
| 22 hours @ $940/Day | 861.74 | |
| 18 hours @ $965/Day | | 723.75 |
| Casing String Costs Total | 5000 | 5200 |
| 1300 to 6000 feet: (mud drilling only) | | |
| Bit Costs:—7⅞" Bit: | | |
| 35 Bits @ $178 | 6230 | |
| Drilling and round-trip time costs: | | |
| 700 hours drilling plus 210 hours round trip at $940/Day | 35,644.70 | |
| Oil String | 15,000 | |
| Intermediate Hole 1300 to 2300 feet with air and 2300 to 2900 with mud: | | |
| Bit Costs:—11" | | |
| 3 Bits @ $256 | | 768.00 |
| Drilling and round trip time costs: | | |
| 33⅓ hours @ $965/Day plus 30 hours @ $975/Day plus 15 hours round trip time @ $965/Day | | 3162.08 |
| Intermediate string costs total | | 9500.00 |
| Hole to pay 2900 feet to 6000 feet) 2900 to 5300 feet with air; 5300 to 6000 feet with mud: | | |
| Bit Costs:—7⅞" | | |
| 19 Bits @ $178 | | 3382.00 |
| Drilling and round trip time costs: | | |
| 240 hours @ $965/Day plus 140 hours @ $975/Day plus 133 hours round trip time @ 965/Day | | 20,685.07 |
| Oil String Total | | 15,000.00 |
| Completion, logging, mud and water costs (including lost circulation losses) | 28,000.00 | 18,500.00 |
| TOTAL | $97,440.44 | $83,975.90 |

In this instance the balance is shifted heavily in favor of air even though an extra casing string has to be set. Conveniently located water zones, a lost circulation problem, and a thick section of hard formation that responded favorably to air drilling all combined to make important savings possible.

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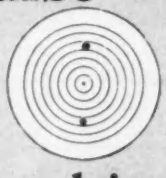
There are other drift indicators, but *Eastman* and only *Eastman* makes one to **DOUBLE CHECK** itself ( 2 readings ) with a 40 second interval between. No batteries light bulbs . . . or photo sensitive discs  are used . . . The **EASTCO** Self Checking Drift Indicator is COMPLETELY MECHANICAL. This instrument is very SMALL and can be go-deviled or lowered into the hole on any conventional line. Operators may contract for this instrument on a low cost daily or term

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From the three examples given here, it is obvious that it will be impossible to draw broad generalizations that can be used to substitute for actual calculations. However, the following rules-of-thumb might be helpful in putting air drilling in perspective:

1. The added cost of the compressor system—if it is part of the rig—is negligible when considered in the light of total well costs. A contractor may safely invest in a compressor system if he operates in any of several areas where lost circulation is a problem and where air can be used for a reasonable percentage of the time.

2. Lost circulation problems offer perhaps the greatest incentive to use air in most areas. There are many instances where the use of air or aerated mud drilling would be justified by reducing lost circulation costs even if there were no drilling speed advantage at all.

3. Air drilling cost advantages are greatest in hard-drilling areas if the formation responds favoraby to air. There is some evidence that the use of air does not speed up drilling very much in certain very hard formations. Where this is the case, the advantages of using air would not be so great. Much more drilling experience is necessary before the full story of how air affects drilling rates is known.

4. An extra casing string is expensive. Generally speaking, other considerations have to be quite favorable to the use of air before the savings will overbalance the cost of an extra casing string.

5. The development of an effective squeeze process to seal off water zones will drastically change the picture in favor of air drilling. Just how much depends on how much a squeeze job will cost and how long it will take.

It is not safe to generalize beyond the broadest rules-of-thumb such as these. If a contractor suspects air might help him reduce costs, he would do well to run calculations for himself like those given in this article. Frequently, he will be astonished at how much air can save. —**The End**

## Hydraulic Drill Collars

*Continued from Page 106*

lars were used for approximately the last 4000 feet of hole. When the hydraulic drill collar was used, extremely heavy vibrations, normally encountered, were almost completely stopped.

Another measure of the roughness of the drilling is the amount of upsetting that occurs on the top surface of the bit sub, as described above, although on the present 12¼-inch hydraulic drill collars this upsetting does not interfere with operation of this tool. The amount of vibrations at the bottom of the hole can be gaged fairly accurately by the upsetting of that surface. The last report on the 12¼-inch hydraulic drill collars would indicate that the intermediate hole in this particular field is one of the roughest holes ever drilled with one of these tools.

Even though the problems caused by the vibrations in a rotary drill string have always existed, it has only been recently that their effect on rotary drilling has been studied. Formations can be separated into two general categories: those with a high coefficient of restitution and those with a low coefficient of restitution. In formations with a low coefficient of restitution, the problems caused by a vibrating drill string are for the most part eliminated, as the formation itself tends to dampen out these vibrations.

On formations with high coefficient of restitution, vibrations in the drill string can be a serious problem. First, the efficiency of the rock bit at the bottom of the hole is greatly reduced, thus giving a reduced penetration rate. Secondly, the destructive effect of those vibrations can be very great on drill string and surface equipment. The use of a dampening unit, such as a hydraulic shock absorber should increase the penetration rate and greatly lengthen the life of the drilling equipment itself.


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[1] H. B. Woods and Arthur Lubinski, "Cut Costs in Crooked Hole Areas," WORLD OIL, July, August, September, 1953.

[2] F. Lawrence Resen, "New Mud Driven Drill Collar Increases Penetration Rate in Lea County Well," *Oil & Gas Journal*, July 19, 1954.

[3] Arthur Lubinski, "A Study of the Buckling of Rotary Drilling Strings," *API Drilling and Production Practices 1950*.

[4] J. P. Bernhard, "La Dynamique du Train de Forage," paper presented at the third World Petroleum Congress.


## New Depths Reached

*Continued from Page 110*

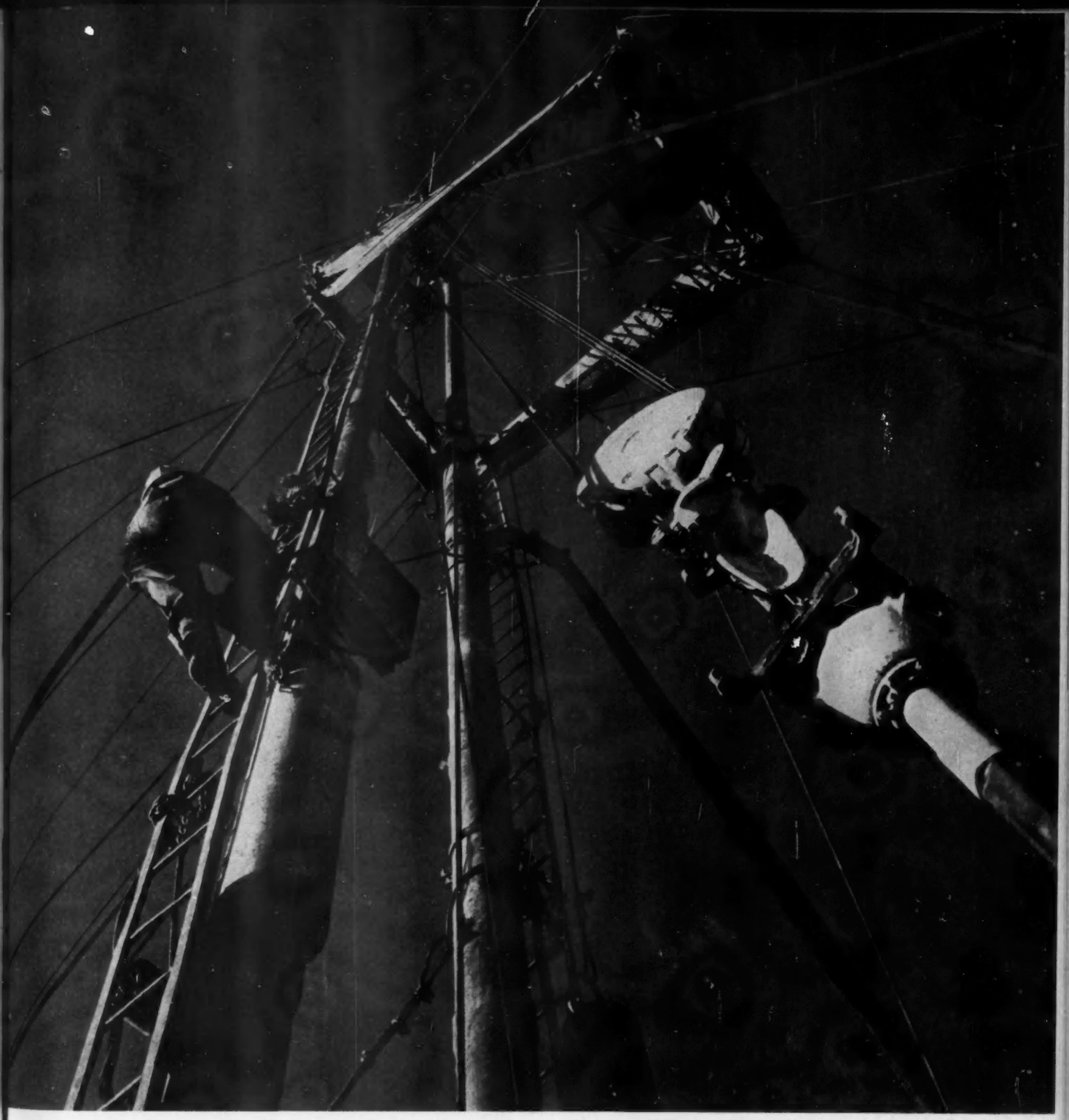
allowed by the contractor for collapse (or crushing) due to the rotary slips.

Around 13,000 feet drilling progress had been notably slow because of cuttings collecting on the walls, Apparently, the above mentioned oil seep gradually had built a deposit of oil and bit cuttings. The hole had to be reamed several times. Drilling was discontinued while wet cuttings were dried and blown from the hole with drill gas. At 13,256 feet the drill pipe was stuck while reaming and gas blowing. A day was required to work the pipe loose. After this, only three 7-inch OD drill collars were used. A combination jar and safety joint was added just above the collars.

At 13,445 feet the pipe again was stuck, but it was jarred loose with little lost time. Finally at 13,732 feet the bit became stuck 60 feet off bottom when an attempt was being made to pull it out of the hole. The drill pipe was stuck above the jars, so a string shot was needed to back off. This was done leaving one set of jars and three 7-inch OD drill collars in the hole. Since the primary objective had been reached, the company decided to abandon the well rather than attempt a costly project of washing over the fish.

Experiences with gas drilling in the San Juan Basin, the Uinta Basin, and the Pinedale structure have shown that, with proper employment of this method, many wells can be drilled that might otherwise prove economically unfeasible. Once again in the Delaware Basin this criteria proved true. The drilling of the No. 1 well took ten months and approximately $1 million to reach the same total depth. Use of gas drilling at the most effective depths allowed the No. 2 well to be drilled in a little over three months at a cost of less than $400,000. In the gas drilled section only 29 bits were used and no drill stem tests were required. The same section of the No. 1 well was mud drilled with a total of 143 bits and seven drill stem tests in testing the zones penetrated.

This experiment with gas drilling in a relatively new area proved that nearly two-thirds of the normal cost of wildcatting could be averted, and a greater depth could be reached than ever attempted before with this medium. —**The End**



**Wire Rope at Work**— They were at a depth of 2443 ft when this photograph was taken, and the plans called for going another 700. The formation was largely anhydrous. Located near Lefors, Texas, the well was being drilled by Frank Woods Associates, Inc., of Wichita Falls.

A light, portable type of rotary derrick served nicely for the fairly shallow drilling. The rotary line of the rig, Bethlehem 1-in. 6x21 Seale, was already a hardy veteran of oil-field service; it had to its credit six previous wells to depths of 3150 ft. This rotary line, by the way, was still going strong and gave every indication of staying in the thick of things for quite a while to come.

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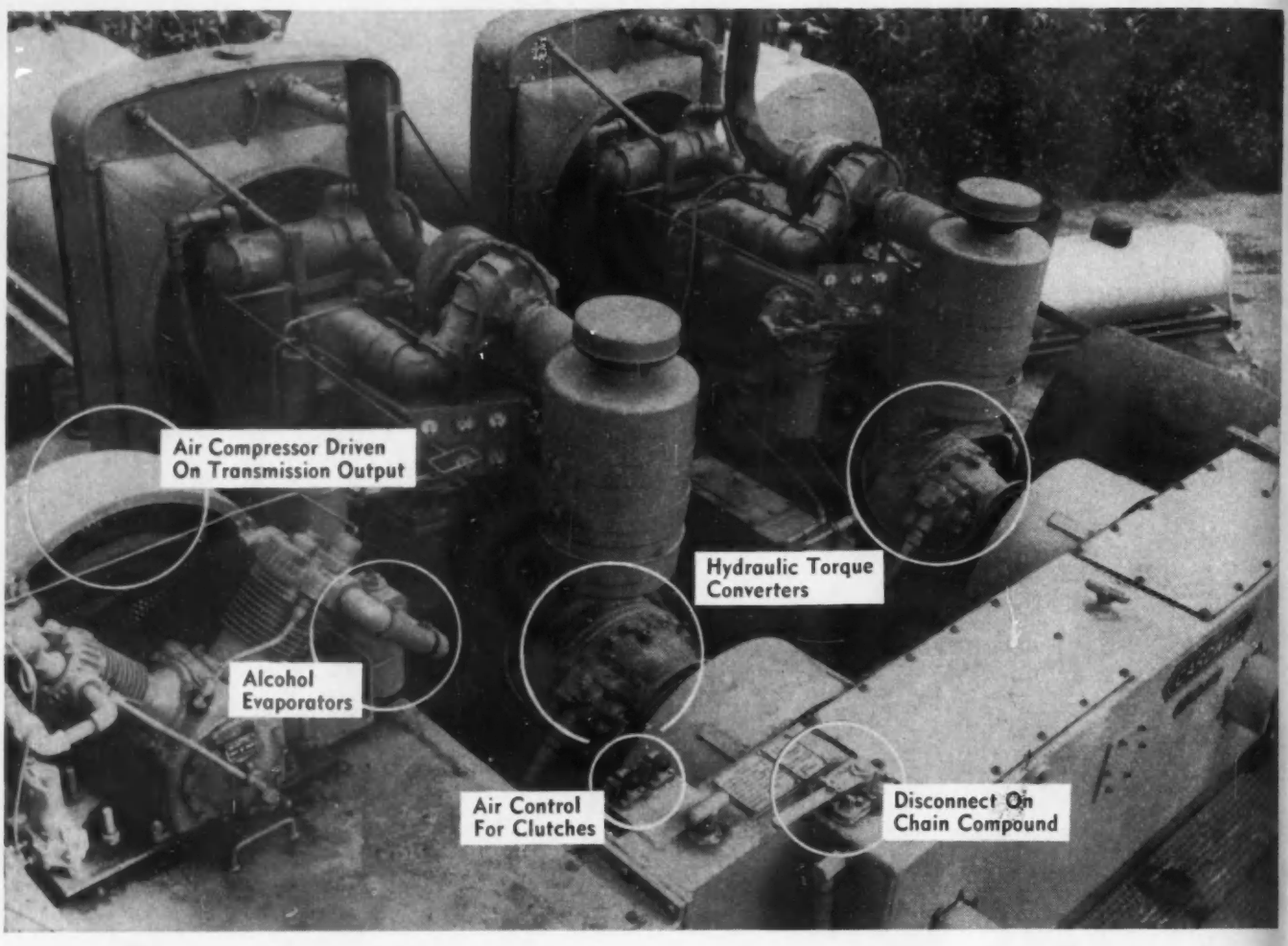


A general view of the two engines, torque converters, engine compounds, and small air compressor on J-450 Cardwell rig.

Announced by Cardwell . . .

# Light Rig Torque Converter Application

**Versatility, power, air controls and light weight are additional features of new rigs operating in Illinois Basin.**

CARDWELL MANUFACTURING Company of Wichita, Kansas, has announced the delivery of the first three of their highly versatile, lightweight, drawworks to the Illinois Basin. One of the main features of Cardwell's new drawworks is that with sufficient power the same unit can be used in the 3500-foot class as in the 5000-foot class. By extending the main frame during construction two engines can be mounted, or the short frame can be used for one engine.

Usually small rigs without a substructure are used in the Illinois Basin, but in the vicinity of Flora and Eldorado, drilling operations are taking place over old abandoned coal mines. A considerable quantity of gas has accumulated under pressure in these mines and when the drill bit drops through into one of the headers it usually causes a blow out, loss of circulation, and in some instances even a fire. Blowout preventers have not been used. Most of the operators after careful planning have tried to locate the rig and direct the bit so that they drilled through some of the ten-foot square mine pillars. Two operators in this area have ordered the new Cardwell units with the nine-foot substructure so that blowout preventers could be used.

The S-350 unit is the single engine rig with split power operating both the rotary table and the mud pump. This small rig is also equipped with a torque converter.

The J-450 rig is capable of 5000-foot drilling or 10,000-foot workovers. It has two engines that can be split for rotary drive and pump power or the two can be compounded to drive

*Continued on Page 132*

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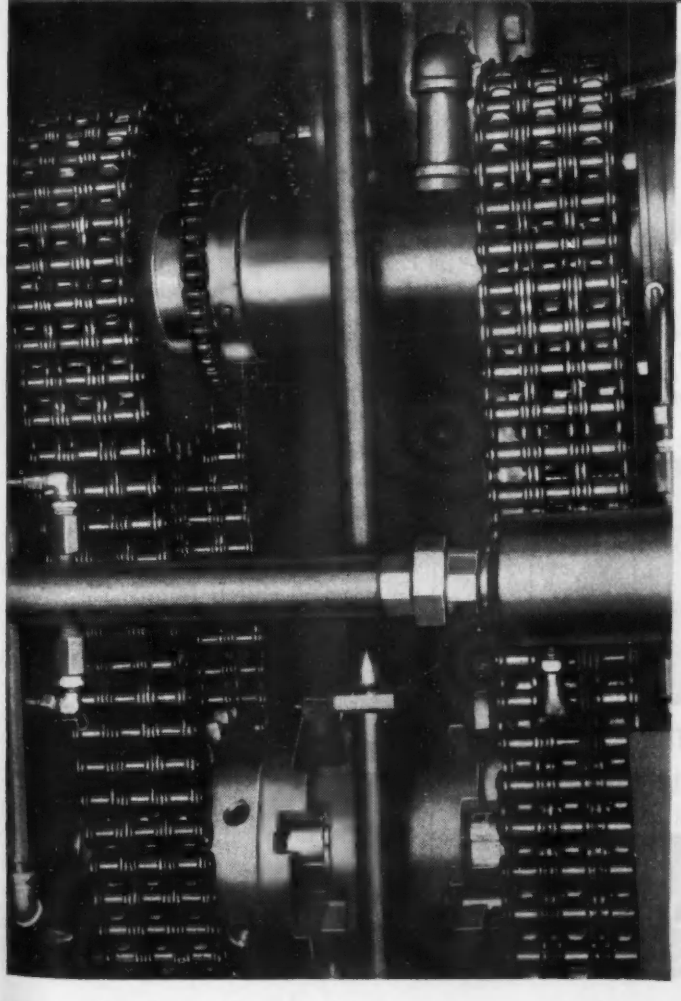

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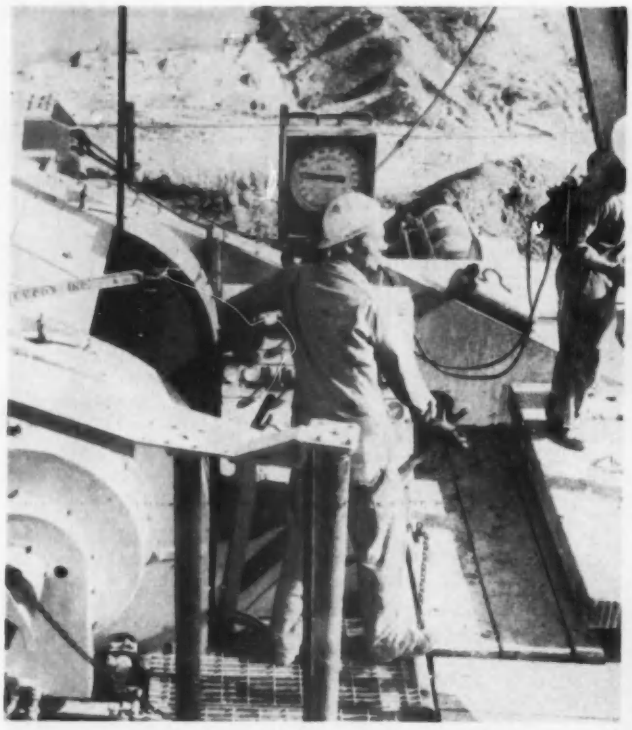

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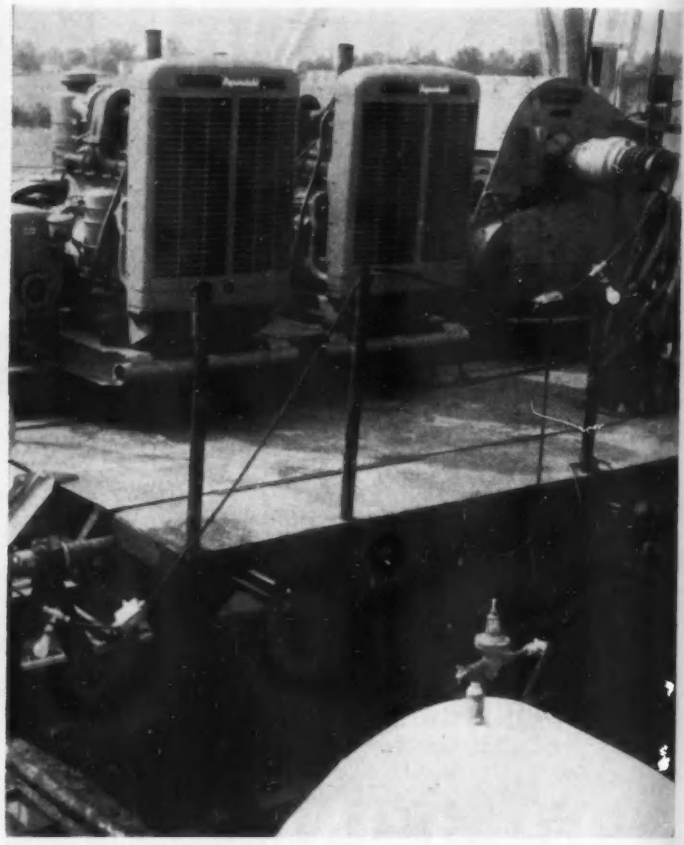

View of the nine-foot substructure. Unusual in the Illinois Basin, it is used to provide a clearance for blowout preventers. Note gas starter for the rear engine. Front engine is started with air.

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Picture *(left)* shows the Heidler Rat-Hole Digger in use on a Cardwell J-450 Rig near El Dorado, Ill.

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The drawworks is so designed that any standard rig accessory can be added.

The rig is fully protected by cross control safety devices to prevent the inadvertent performance of any unwanted operation. All operations can be performed with optional clutches. In case of clutch failure the clutch can be locked in place to form a rigid member and it can then be backed up by another clutch.

Although these rigs with 136 foot masts, and nine foot substructures are large in comparison to past operations in this area, they are providing the added margin of safety with the adaptability for blowout prevention and the owners are also looking forward to deeper drilling prospects in the Illinois Basin. —The End

**About the Author**

D. O. JOHNSON, a partner in Johnson-Fagg Engineering Company, Tulsa, is engaged in consulting and engineering service work on oil well pumping as well as the manufacturing of special products for oil production. Before 1946 he was busy in the design and application of industrial electrical equipment and in sales engineering for the petroleum industry. He also has had experience in personnel training.

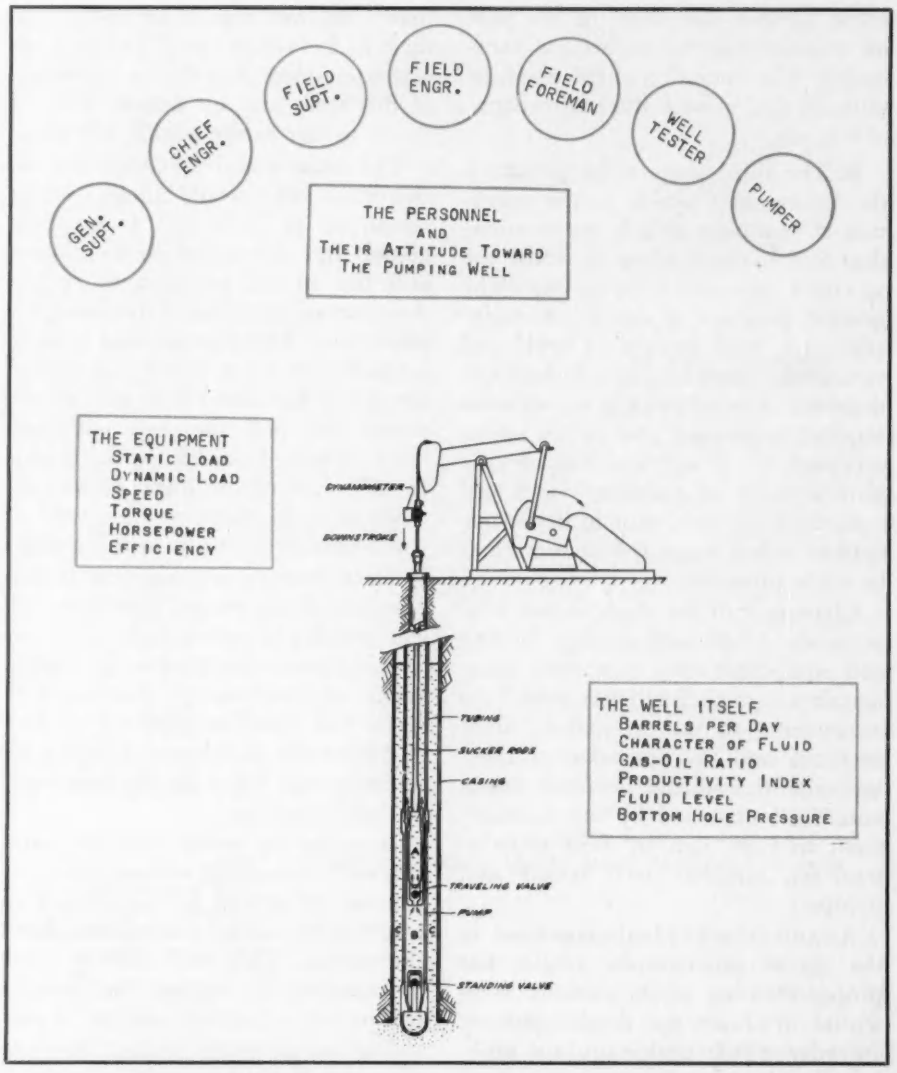


**FIGURE 1—The complete pumping well picture.**

### A full three-dimensional picture that puts . . .

# Pumping Well Problems in Focus

**The proper use of available instruments and the education of field personnel means: Pumping problems can be analyzed to give adequate data for proper servicing and equipping of pumping wells.**

**By DOUGLAS O. JOHNSON**
Johnson-Fagg Engineering Co.
Tulsa

THERE HAS BEEN considerable progress during the past 20 years in the methods, materials and equipment used in the artificial lifting of oil by means of pumping equipment. Even more progress can be made by the careful correlation of all factors involved.

There are three general aspects to consider in connection with pumping well operations. (See Figure 1).

**1.** The first is the well itself. Its potential capabilities to produce must be known. How this ability to produce is affected by proration and by the passage of time must be known. Some knowledge is essential as to whether the well will sustain fluid volume over a period of years or whether there will be a decrease due to depletion or maybe an increase due to water encroachment. The particular fluid condition of the well must be taken into account.

**2.** The second part of the pumping picture is the equipment used to produce the well. The prime mover, pumping unit, polished rod, stuffing box, sucker rods, pump and tubing must be considered as a complete ma-

chine, so that the effect of one part on another may be understood thoroughly. The operation of this machine must be tied in with the performance of the well.

**3.** The third part of the picture is the background which in the operation of pumping wells is the relationship and understanding of all of the various personnel involved. The general program of operation, maintenance, and repair of well and equipment must be one which is understood by everyone from superintendent to pumper, and one in which everyone is in accord. Engineering studies made on pumping wells and equipment do not result in better operation unless suggested changes can be made promptly.

Changes can be made more economically to prevent damage to well and equipment than to correct damage already done. Engineers must have instruments to use in making their decisions and the operation of these instruments and the decisions made must be understood by top management and in turn by field superintendents, foremen, well testers and pumpers.

Anyone who has had experience in the art of photography knows that proper focusing of the camera is essential to obtain the desired picture. In order to fully understand the problems involved in the operation of oil wells being produced by sucker-rod type of pumping, it is essential that all of the factors involved be viewed as a complete picture. Each factor must be brought into focus separately and then the composite problem viewed as a full three-dimension picture. A few examples will show that when attention is focused on only a few factors, the solution of the real problem is not in sight because the real problem is not clear. The whole picture is clouded.

In a recent study made to diagnose sucker-rod failures, the pertinent facts were revealed as follows: Sucker rod failures became too excessive and the operator felt that the rods were defective. Samples of the rods were sent in for laboratory analysis and the rods were up to standard.

The well was reported to be running with a pumping cycle of 22 44-inch strokes per minute, and polish rod load calculations were made with this pumping speed as a basis.

When a dynamometer study was made, the well was found to be running 25.2 44-inch spm. The pumper was questioned as to the normal speed of this well, and his answer was, "I run it as fast as the engine will go."

The stroke length was 44 inches but the crank holes would allow a stroke length up to 74 inches. It was suggested that the stroke be lengthened and the strokes per minute be cut down so as to maintain the same displacement. The pumper said that an attempt had been made to lengthen the stroke but that the engine simply would not pull the well with any longer stroke. In order for this engine to take care of the horsepower requirements in pumping this well, it was necessary to run it at top speed.

Upon further investigation it was found that the reason that this well was running at such a high speed was to try to overcome the ever increasing water encroachment. This added water was being encountered because of other wells in the area which were disposing salt water in the same producing formation.

In order for sucker rods to pump this well successfully without excessive trouble, it would be necessary to lengthen the stroke and to slow down the motion. This could only by done by changing the engine. The problem was not one of sucker rods but of providing an adequate prime mover to take care of the increased horsepower necessary to pump the added volume of fluid from this well.

The low volumetric efficiency encountered in the pumping of a comparatively new well, was the key factor in bringing out the real problem. In a well 7000 feet deep the selection of equipment and operating cycle was carefully engineered with excellent technical data available. Bottom hole pressure measurements were correlated to subsequent fluid level measurements. Production rates were set so that the pump would always have 500 to 600 feet of submergence. Fluid samples from the bottom of the hole showed very little gas in solution in the oil. There was a slight water encroachment but no indication that it would increase in the future. The pumping rate was set at 12 64-inch spm. The low apparent volumetric efficiency of 40 percent, prompted a study of the well and an abnormal load condition was recorded by a polished rod dynamometer. The solution to this problem was simple when it was realized that the abnormal load was the result of slack in the tubing due to the fact that too much load had been placed on the tubing anchor set directly above the pump. This extra load had also been indirectly noted by the field foreman who found it difficult to get enough counter-balance on this well.

In a third case an important test on a new sucker rod material was to be terminated because of excessive failures. Dynamometer tests were made but nothing unusual was disclosed. When attention was directed to the well servicing records, it was discovered that the excessive failures immediately succeeded a bad stripping job due to a stuck pump. The rods were without a doubt, mistreated during the stripping operation. An important test in this case would have been terminated prematurely with a bad conclusion if the above facts had not been properly brought out.

An engineer was sent out from headquarters to a comparatively new pumping field to investigate what was reported as premature failure of sucker rods in many of the wells. No advance information was given this engineer as to the policy of the company regarding the operation of this field. After measuring loads and fluid levels the equipment was found to be badly overloaded. The reason finally revealed was that top management had made a pipe line commitment which was impossible to fulfill by the capacity of the wells. Neither the wells nor the equipment were capable of what they were being asked to do.

## THE WELL ITSELF

In order to understand the problems involved in a pumping well, the factors of the well itself must be considered first. This is the primary consideration because the well itself defines the job to be done.

It is essential to know the productivity index of the well so that its potential fluid volume can be determined. The character of the fluid itself is very important. What is the gas-oil ratio? Is the gas free or in solution? What is the percent water cut? How will the fluid character change over a period of years? Will the production be limited by proration? Is the fluid very viscous and does it have a high paraffin content? Is it expected to be corrosive? Will the well be pumping a lot of sand?

The answers to the above questions

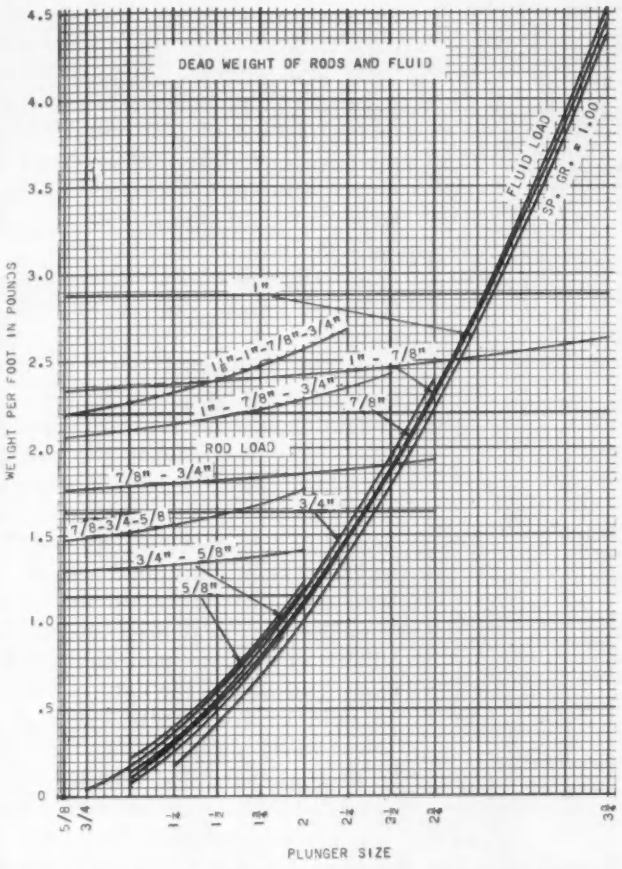


**FIGURE 2—The rod weight per foot in pounds for a specific size plunger is found by tracing the vertical line corresponding to the plunger size to the appropriate rod curve and horizontally to the weight scale. The fluid weight per foot in pounds is found in a similar manner applying the fluid load curve.**

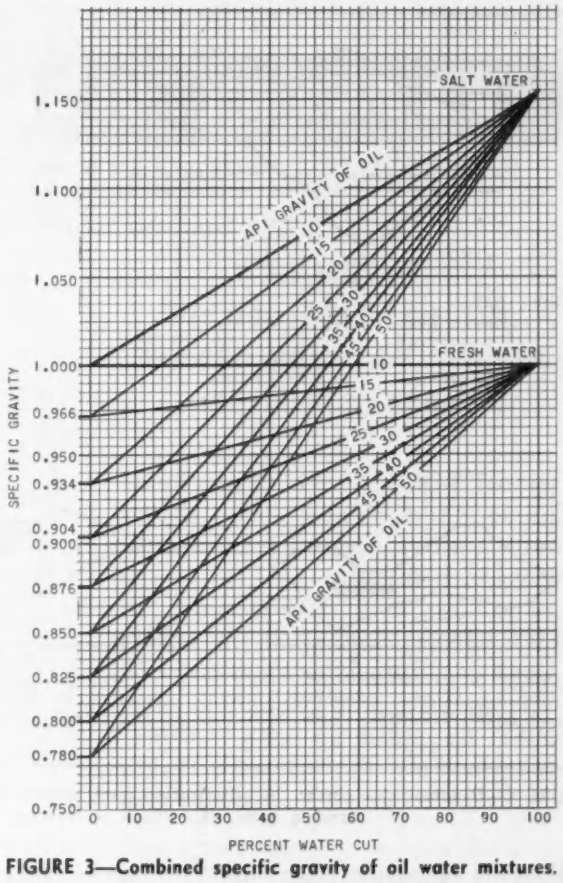


**FIGURE 3—Combined specific gravity of oil water mixtures.**

must come from the petroleum engineers and geologists who have made a study of the cores taken during drilling operations and the initial tests of the well and fluid. Build-up of fluid level is a part of determining the productivity index. Careful analysis of samples of fluid collected from the bottom of the well shows the character of the fluid.

Whenever possible the producing rate of an individual well should be set by the petroleum engineer after considering the effect on the reservoir. It is realized that competition between operators in any one field may make it tempting to speed up wells, but even then no well should be run so as to damage either the equipment or the well itself.

## THE EQUIPMENT

All of these factors can have a marked effect upon the maintenance of the equipment and the operation of the well. The second big part of the pumping well total picture is the selection, operation and maintenance of pumping equipment. Attention must be focused on all of the following factors:

1. Load
   A. Static
   B. Dynamic
2. Speed
3. Torque
4. Horsepower
5. Efficiency

**Load.** Generally accepted comments on pumping wells usually refer to this well or that well as a heavy well or a light well. The terms light or heavy are of course relative terms, and it is not the actual load in pounds which makes a load heavy as far as equipment is concerned, but rather the number of pounds per square inch to which the equipment is being subjected. In order to consider whether the particular load on a well is what it should be, we must consider the factors contributing to that load. First consider those forces which we may generally describe as static.

**Load (Static).** The static or dead weight of sucker rods in air is easily calculated from the weight per foot of the various sizes. The chart in Figure 2 gives the average weight per foot of single sized rod strings and combination or tapered strings.

In making a dynamometer study on a pumping well, the simplest factor to measure is the dead weight of sucker rods.

The weight of rods in fluid is simply the weight in air minus the buoyancy of the fluid. Buoyant force according to physics (Archimedes principle) is equal to the weight of the volume of fluid displaced by the sucker rods. The volume of sucker rods is equal to the weight in air divided by the weight of a cubic foot of steel (490 pounds). The volume of the rods multiplied by the weight of a cubic foot of water (62.5 pounds) would give the buoyancy if the rods were suspended in fresh water. To correct this factor for the individual well, the specific gravity must be taken into account. For wells producing solid fluid, including oil-water mixtures the actual specific gravity of the fluid may be obtained with fair accuracy; but in gassy wells, it may have no definite value. The combined average specific gravity of oil-water mixtures is obtained by the

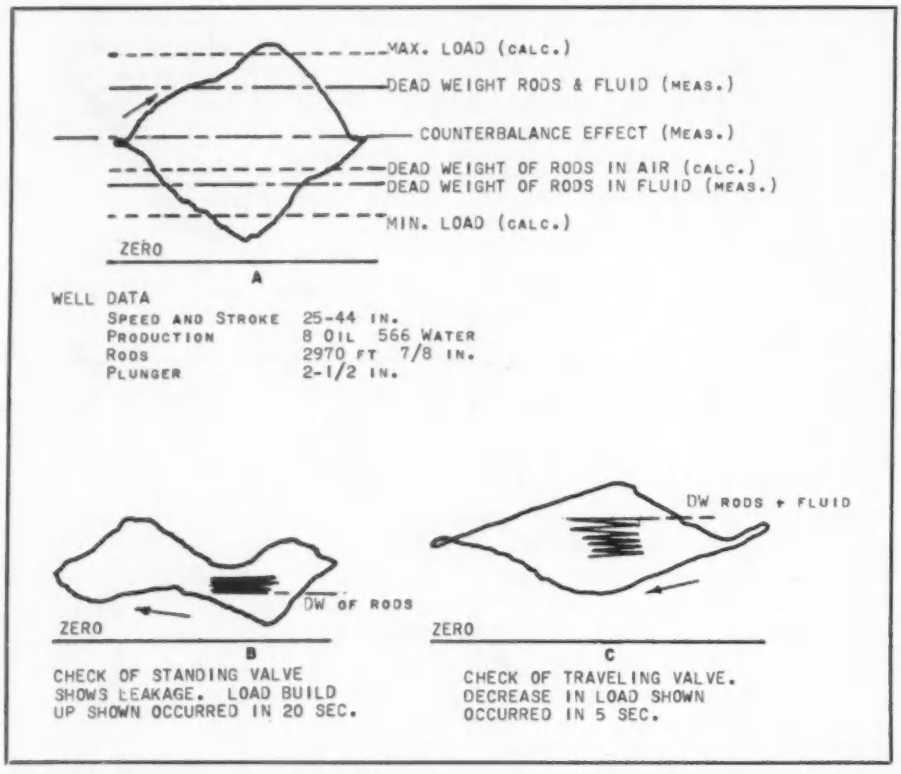
MAX. LOAD (CALC.)
DEAD WEIGHT RODS & FLUID (MEAS.)
COUNTERBALANCE EFFECT (MEAS.)
DEAD WEIGHT OF RODS IN AIR (CALC.)
DEAD WEIGHT OF RODS IN FLUID (MEAS.)
MIN. LOAD (CALC.)
ZERO
A
WELL DATA
SPEED AND STROKE 25-44 IN.
PRODUCTION 8 OIL 566 WATER
RODS 2970 FT 7/8 IN.
PLUNGER 2-1/2 IN.
DW OF RODS
ZERO
B
CHECK OF STANDING VALVE SHOWS LEAKAGE. LOAD BUILD UP SHOWN OCCURRED IN 20 SEC.
DW RODS + FLUID
ZERO
C
CHECK OF TRAVELING VALVE. DECREASE IN LOAD SHOWN OCCURRED IN 5 SEC.

**FIGURE 4—Dynamometer cards: (A) illustrating load pattern for entire stroke, (B) check of standing valve, (C) check of traveling valve.**

following equation: S.G. (mix) = $\frac{\text{S.G.}_o\ (\%\ \text{oil}) + \text{S.G.}_w\ (\%\ \text{water})}{100}$

The chart shown in Figure 3 is a convenient way to obtain these values.

The dead weight of rods in the fluid may be checked with the dynamometer by stopping the motion on the downstroke so the full fluid column is supported by the standing valve and tubing.

This reading is important in dynamometer well study work because it is a quick check to see whether the load readings make sense. It also checks the operator of the dynamometer as to whether he is reading the correct scale on the instrument. Sometimes this reading may reveal discrepancies in sucker rod records. If this reading shows the rod load too light, there may be some excessive down-the-hole friction.

If the dead weight of rods in fluid changes quite materially over a short period of time, the standing valve may be leaking. The dynamometer would show an increase in load as the fluid load would be transferred back to the rod string. This reading has another very important aspect in that it is used to check the condition of the standing valve of the pump.

In measuring the dead weight of rods in fluid, care should be taken that the well is stopped on the down stroke and not stopped too suddenly. A sudden stoppage might mean that the plunger will continue in motion and might oscillate several times so that the operator would not know if the full fluid load was completely off the sucker rod string and being supported on the standing valve.

In considering the buoyant force on the rods, we find the first tie-in between the equipment and the specific character of the fluid from the well.

The dead weight of the fluid is the next important consideration and in addition to knowing the specific gravity of the fluid, the pumping fluid level must be known in order to make proper calculations.

The dead weight of the fluid is checked with the dynamometer by stopping the pumping motion on the up stroke so that the fluid column in the tubing is carried by the traveling valve, pump plunger, and sucker rods.

In making this test, the reading must be taken quickly because the leakage of the fluid past the pump plunger will reduce the load over a short period of time; depending upon the fit of the plunger and the effective differential pressure across it. This differential pressure depends on the depth of the well and the actual working fluid level of the well. If the traveling valve is leaking the load will reduce more rapidly as the fluid column load shifts to the standing valve and tubing. This change-over is not instantaneous because of the relative stretch of rods and tubing as the load is transferred. It should be noted that in checking the dead weight of fluid, the fluid level is the working fluid level and not the static level. The fluid level of course starts to build up as soon as the well is stopped and this is another reason why the fluid load must be taken without delay.

The change in the load shown by the dynamometer, when checking the fluid load, is another step in tieing the well characteristics in with the problem to be met by the equipment. The so-called static fluid load will change with time due to the aforementioned slippage past the plunger and the possibility of leakage past the standing valve and also by the natural build up in fluid level of the well as it is allowed to set idle.

This measurement should also be made after the well has been stopped, and not too suddenly, because if the plunger bounces a few times the full fluid load may not be on the plunger. In order to show how greatly the fluid load increases with the size of the plunger, refer to Figure 2.

In checking the fluid load, the first chance is afforded to tie together the fluid level measurements with the actual load recorded. In a very high fluid level well, the up stroke dead weight and the down stroke dead weight will be very near the same because there is very little fluid load.

In using the dynamometer to detect the rate of leakage of the pump valves, some experience is needed in each type and fit of pump at various depths to know what might be the normal rate of leakage past the plunger.

If abnormal dead weight readings are recorded, it is well to look for friction factors like crooked holes, paraffin, slack in tubing, tight pump plungers, etc.

Figure 4-A shows the position of the dead weight of rods and fluid as referred to the load pattern recorded by the dynamometer for the entire stroke.

One other static load determination which is generally made with the dynamometer, is that of measuring the peak counter balance effect at the polished rod. (See Figure 4-A.) This measurement may be checked against

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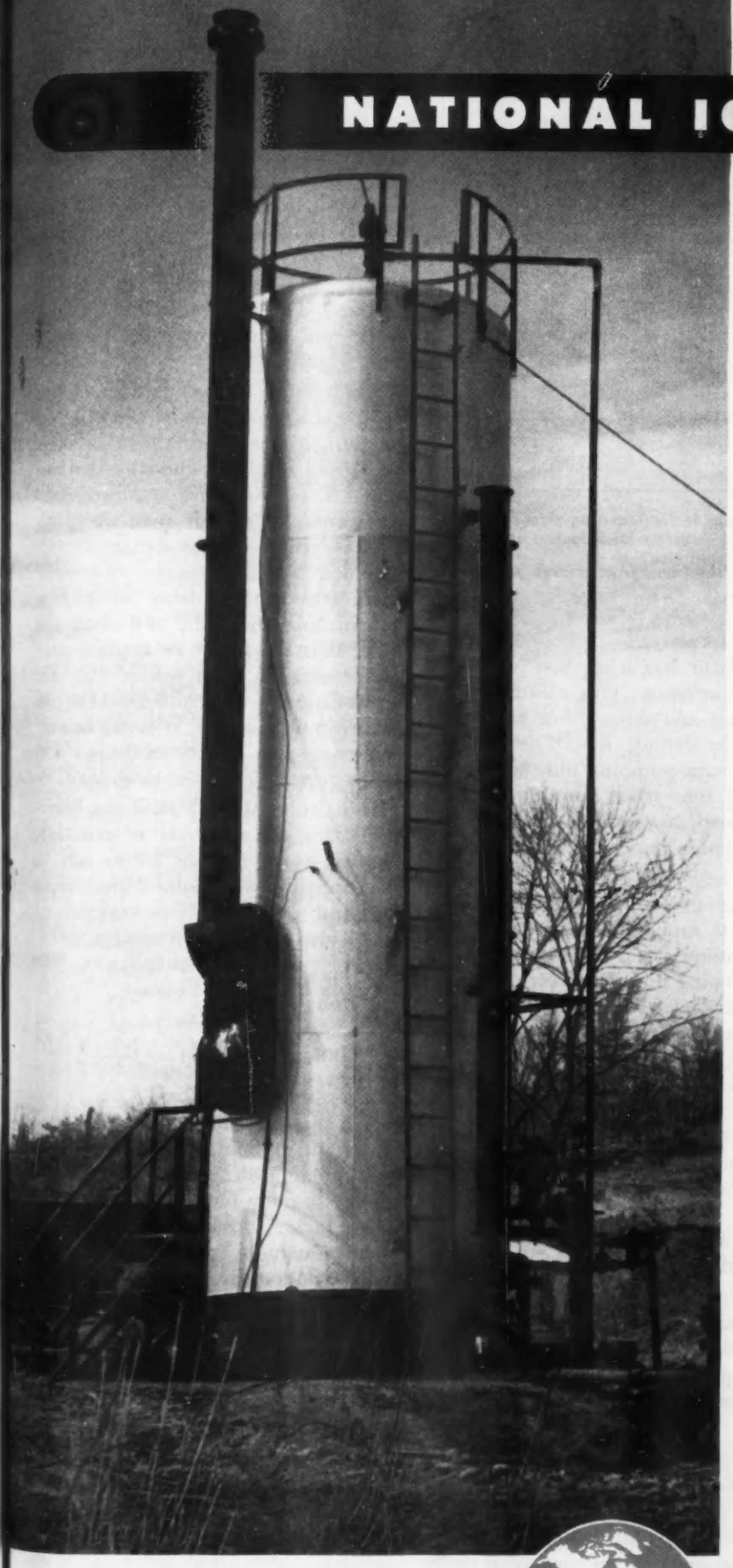

## HANDLES
## 776,920 BBLS. OF OIL
## 823,486 BBLS. OF WATER
## IN THREE YEARS

This 8′ x 27′6″ National IC-P Treater was set on a lease in Hughes County, Oklahoma. In approximately three years, this Treater handled 776,920 bbls. of oil, with a substantial increase in conserved gravity, and 823,486 bbls. of water. At times, rate of crude flow through the Treater was as high as 3400 bbls./day when wells were at peak production.

Average treating temperature is about 140°. Approximately 1 quart of chemical is used per 100 bbls. of oil. During this three-year period, tank bottoms were never cleaned or treated.

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| Strokes per Min. | Length of Stroke, in. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 18 | 24 | 34 | 44 | 54 | 64 | 74 | 84 | 96 | 108 | 120 | 144 | 180 | 240 |
| 2 | | | | | | | | | | | | | | | 1.014 |
| 4 | | | | | 1.010 | 1.012 | 1.015 | 1.017 | 1.019 | 1.022 | 1.025 | 1.027 | 1.033 | 1.041 | 1.055 |
| 6 | | | 1.013 | 1.017 | 1.023 | 1.028 | 1.033 | 1.038 | 1.043 | 1.049 | 1.055 | 1.062 | 1.074 | 1.091 | 1.124 |
| 8 | 1.011 | 1.016 | 1.023 | 1.031 | 1.040 | 1.049 | 1.058 | 1.068 | 1.076 | 1.088 | 1.099 | 1.110 | 1.132 | 1.162 | 1.220 |
| 10 | 1.017 | 1.026 | 1.035 | 1.048 | 1.063 | 1.077 | 1.091 | 1.106 | 1.120 | 1.136 | 1.155 | 1.172 | 1.207 | 1.260 | 1.345 |
| 12 | 1.027 | 1.037 | 1.051 | 1.070 | 1.091 | 1.111 | 1.131 | 1.152 | 1.172 | 1.198 | 1.222 | 1.247 | 1.296 | 1.365 | 1.495 |
| 14 | 1.034 | 1.050 | 1.070 | 1.095 | 1.124 | 1.141 | 1.178 | 1.206 | 1.236 | 1.266 | 1.297 | 1.335 | 1.402 | 1.500 | 1.670 |
| 16 | 1.044 | 1.066 | 1.091 | 1.125 | 1.162 | 1.197 | 1.232 | 1.281 | 1.307 | 1.348 | 1.390 | 1.437 | 1.525 | 1.650 | |
| 18 | 1.056 | 1.083 | 1.116 | 1.157 | 1.205 | 1.250 | 1.294 | 1.343 | 1.390 | 1.440 | 1.495 | 1.555 | 1.665 | | |
| 20 | 1.069 | 1.102 | 1.142 | 1.194 | 1.252 | 1.307 | 1.362 | 1.423 | 1.475 | 1.542 | 1.610 | 1.685 | | | |
| 22 | 1.083 | 1.124 | 1.180 | 1.235 | 1.305 | 1.372 | 1.440 | 1.512 | 1.605 | 1.655 | 1.740 | | | | |
| 24 | 1.099 | 1.147 | 1.205 | 1.280 | 1.362 | 1.440 | 1.520 | 1.610 | 1.690 | | | | | | |
| 26 | 1.116 | 1.172 | 1.242 | 1.330 | 1.427 | 1.515 | 1.610 | 1.705 | | | | | | | |
| 28 | 1.135 | 1.200 | 1.278 | 1.385 | 1.495 | 1.595 | 1.710 | | | | | | | | |
| 30 | 1.155 | 1.230 | 1.320 | 1.437 | 1.562 | 1.685 | | | | | | | | | |
| 32 | 1.175 | 1.262 | 1.365 | 1.495 | 1.642 | | | | | | | | | | |
| 34 | 1.200 | 1.297 | 1.407 | 1.560 | 1.725 | | | | | | | | | | |
| 36 | 1.223 | 1.332 | 1.456 | 1.625 | | | | | | | | | | | |
| 38 | 1.248 | 1.370 | 1.508 | 1.700 | | | | | | | | | | | |
| 40 | 1.275 | 1.405 | 1.561 | 1.775 | | | | | | | | | | | |

**FIGURE 5—Impulse factor. This tabulation shows the impulse factor based on simple harmonic motion. Calculated from the relationship: impulse factor = 1 + acceleration factor; acceleration factor = $C = \frac{LN^2}{70500}$ where L = length of stroke in inches N = number of strokes per minute.**

the counter balance tables which are generally furnished by the various pumping unit manufacturers. By actually measuring the counter balance effect with a dynamometer, quick adjustments can be made and simultaneously checked to see that the correct amount of counter balance effect is being obtained. The newer pumping units are being provided with means of quickly and easily changing the counter balance.

By this method of checking counterbalance effect, various technical and non-technical personnel can go out and get identical results on a particular well. This then is the most accurate way of counter balancing. More details on this and other methods will be discussed later.

The static load determinations and their significance can readily be understood by all of the non-technical field personnel. The significance of checking a pump valve and counter balance effect is often quite revealing to the pumper in charge of the particular well. He can readily use dynamometer data to make his wells run smoother and to know just when it is time to service the pump.

**Load (Dynamic).** Everyone has experienced the feeling of being heavier when an elevator starts upward and lighter when it starts downward. To prove that this is so, one needs only to stand on a scale in an elevator and to see the actual change in load.

One of the fundamental laws of physics is that a freely swinging pendulum has a motion which is simple harmonic. This means that it speeds up and slows down according to a very definite law. The conventional beam pumping unit is so constructed that when running at constant speed the motion at the polished rod is approximately simple harmonic.

Just how close the motion of a pumping unit conforms to simple harmonic motion is dependent upon the geometry and speed pattern of the pumping unit. Geometry includes the position of the crank, the length of the pitman, the position of the tail bearing, the length of the beam, etc. The speed pattern depends upon the torque variation throughout the pumping cycle, which in turn affects the variation in speed of the engine or motor operating the unit. The torque variation is affected by the range of load and the degree of counterbalance.

Mathematical analysis of simple harmonic motion shows that the peak acceleration which comes at the end of the stroke, is given by the following expression

$$\frac{N^2L}{70,500}$$

Where N is the number of strokes per minute and L is the length of the stroke in inches. This expression really indicates the percentage of load which is added to the normal weight of the sucker rod string when it is speeded up or accelerated.

It should be pointed out that the calculation of peak dynamic load is complicated by the fact that the whole rod string is not accelerated at one time because it acts like a long spring. To facilitate calculations, the term "impulse factor" was born. It is the factor by which the weight of the rods is multiplied to give the peak load or force. For purpose of calculation, simple harmonic motion is assumed. The impulse factor for any speed and stroke may be obtained from Figure 5.

For many years calculations of the peak loads were made by multiplying the sum of the dead weight or rods and dead weight or fluid by the impulse factor and the resulting load was generally greater than the peak load measured by the dynamometer. This led Mills[1] to suggest that since there was a time delay when first accelerating the rods, and then the fluid, that the factor be applied only to the rods. In other words, since the acceleration of rods and fluid do not come simultaneously, it is reasonable to assume that the forces do not add up to give the expected peak load.

In calculating peak load, the buoyant force on the rods is generally omitted since friction forces act in the opposite direction. This simple method of calculation has proved very valuable in the general application of pumping equipment. The formula is given as follows:

$$PL = W_f + W_r\left(1 + \frac{N^2L}{70,500}\right)$$

which means, polished rod load (lb.) = weight of fluid, (lb.) + weight of rods in air, (lb.) times the impulse factor. Impulse factor = 1 + acceleration factor. Other formulas have been presented from time to time, and no doubt others can be presented to give closer results to measured loads for specific depths and speeds.

The shortcomings of any formula can be appreciated readily when consideration is given to the fact that the peak load is affected by so many variable factors.

As has already been indicated, the motion of the pumping unit is truly not simple harmonic because of the geometry of the linkage of which the pumping unit is composed, even though constant crank speed is assumed.

The speed of the crank is not constant due to the speed variation of

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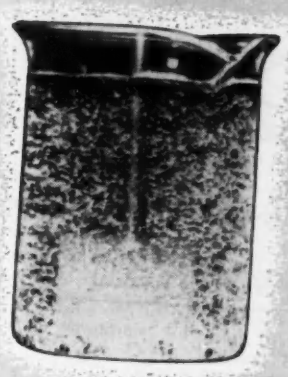
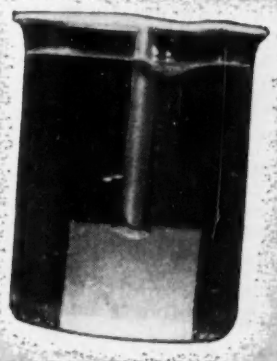


Alum



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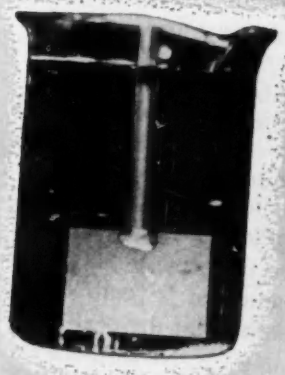

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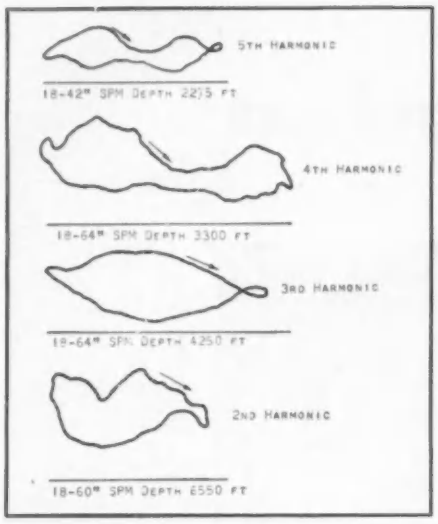


**FIGURE 6—Effect of harmonic vibrations of rod string on load characteristic. Speed constant with depth varying.**

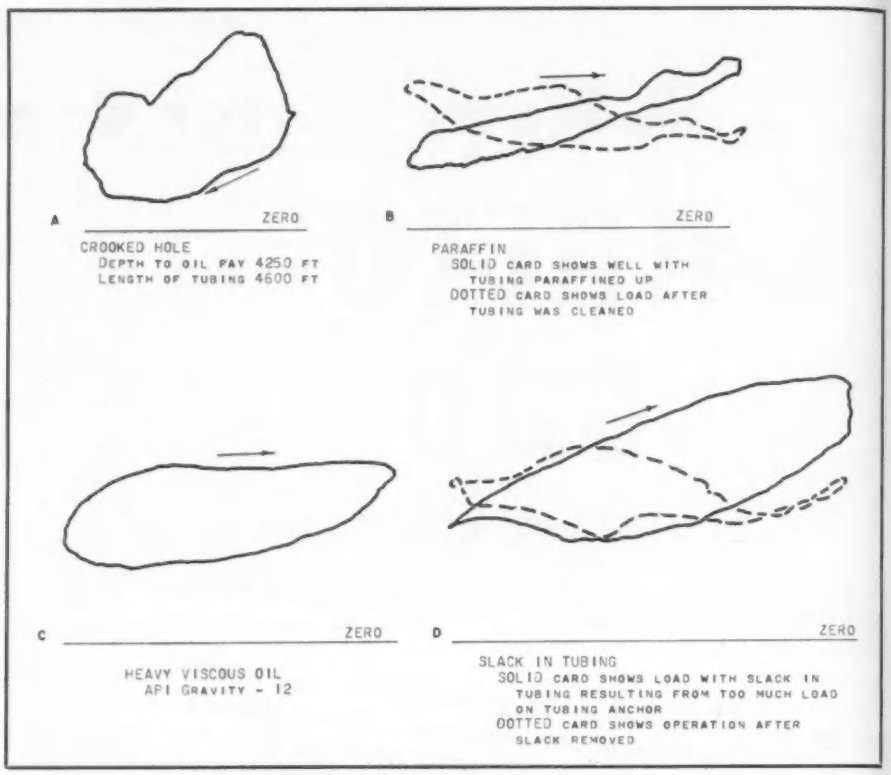


**FIGURE 7—Abnormal friction loads.**

the prime mover. This is the result of the variable load that is placed on the prime mover which means that the speed will vary unless there is enough fly wheel effect to absorb the peak requirements. In shallow high fluid volume wells, the variation in speed of a multi-cylinder gas engine or an electric motor may be as high as 30 percent.

Speed variation may be affected at times by the operation of the governor on the engine, which may be set with too much sensitivity and thus cause speed-ups at different points in the stroke. Also the fluid load can change considerably from time to time in some wells because of the general behavior of the well itself.

The instantaneous forces acting on the polished rod, are affected by the natural fundamental vibration of the rod string, and the harmonics of this vibration. This is true to such an extent that under normal conditions a definite pattern of dynamometer card or load characteristics may be expected at specific depths and speeds. See Figure 6 in the general discussion under the heading of "Speed." This changes the position of the peak load in the pumping cycle. No formula yet proposed takes into acount the rod vibration or tries to define the position of the peak load.

Unknown friction forces can make measured loads considerably above calculated loads and can greatly alter the position of the peak load in the pumping cycle.

Figure 7 shows a few examples of high friction caused by such factors as crooked holes, paraffin, heavy viscous fluid, and slack in the tubing. There are many other factors which could influence the peak load, however, it is believed that the above discussion and examples will serve to illustrate that it is not a simple matter to calculate the expected peak load on a pumping well.

The peak load alone is not sufficient to evaluate a sucker rod and a pumping unit performance. The minimum load is of equal importance, because then we are able to get the range of load through which the rods and unit are operating.

If we assume that the unit is operating with simple harmonic motion, the peak acceleration on the down stroke would be the same as on the upstroke, but in the opposite direction. It is then logical to subtract the same percentage from the weight of the rods as was added on the up stroke to give the dynamic weight on the downstroke. Also the buoyant force on the sucker rods must be considered because it acts in the same direction as any friction present.

The simple formula for minimum load is then

$$PL\ (Min) = W_r\ (1 - c) - W_r \frac{62.5}{490}$$

Minimum polished rod load = weight of rods (lb.) (1 — acceleration factor) — buoyancy force (lb.).

Laboratory fatigue tests on various steels show that as the range of load to which the steel specimen is subjected, decreases the peak load may be increased for the same fatigue life. The diagram shown in Figure 8 is the well known Goodman diagram found in many books on strength of materials and machine design. It makes good sense that sucker rods and pumping unit parts will fail quicker when the range of load or variation of load is great.

Dynamic load is the load actually recorded by the dynamometer. Simple calculations of peak load and minimum load serve to indicate whether the recorded load seems to be in line with expectation. When the load is much greater or much less than expected, then there must be a reason. This is the signal for the person making the study of the pumping well to look for the reason.

Calculation of load, and actual recordings, help to compare different wells. Two wells equipped identically and running about the same speed, producing from the same depth and

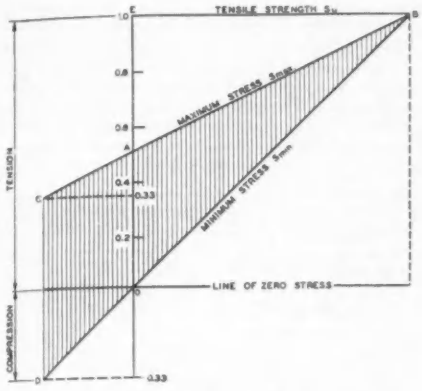


FIGURE 8—Goodman's Diagram.

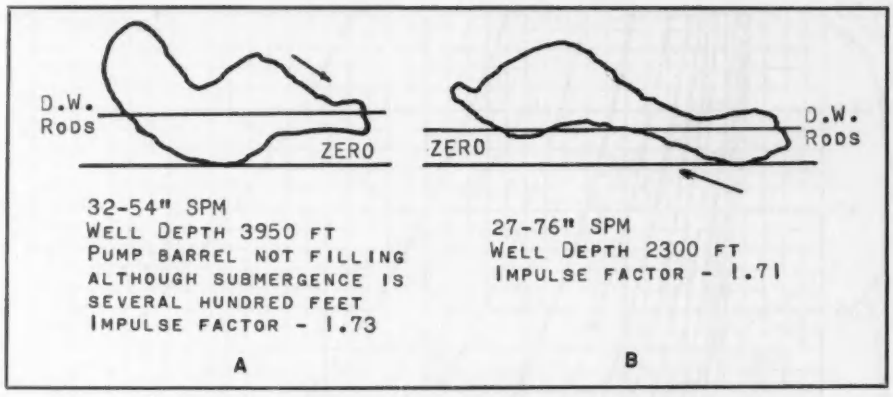


FIGURE 9—High speed operation with minimum load zero.

formation, can often give dynamometer cards that are very different.

The range of dynamic load and the position of the peak and minimum load, greatly affects the peak torque and horsepower requirements of the unit, and will be discussed later under the proper headings.

**Speed.** The number of strokes per minute is really not the true measure of the speed of operation of a pumping well. It is the actual linear travel of the polished rod in feet or inches per minute which is the true index of speed of operation. Very often a well which is operating with a very long stroke and comparatively few strokes per minute will be classed as a slow operation. When the strokes per minute are multiplied by the length of the stroke, the well is found to be operating at a very high average polished rod speed.

There is a very definite maximum average polished rod speed above which it is impractical to operate. When the product of the strokes per minute and the length of stroke is 2000 inches per minute, the operating speed is as high as is practical. Actually the average polished rod velocity is double this because the polished rod actually travels twice the length of the stroke on each pumping cycle.

The limiting number of strokes per minute for the shallower wells is the speed at which the polished rod hangar of the pumping unit runs ahead of the sucker rods on the down stroke. In other words, the beam hangar is dropping faster than the natural fall of the rods. Generally when the acceleration factor is as high as 65 to 75 percent the minimum load on the downstroke in the shallower wells approaches zero. This will vary from well to well dependent upon the friction forces which retard the fall of the rods. Operating with the minimum load at zero, is generally bad because of the slack and subsequent jerks resulting in the component parts of the surface unit. Examples of sucker rod installations where the minimum load is zero, are given in Figure 9.

The strokes per minute at which a pumping well is operating determines the number of major reversals of stress on the rod string. Coupled with the maximum load and range of load, the number of reversals is the other important factor in a consideration of fatigue failures. With a given stroke length, increased speed generally means increased peak load, a decreased minimum load, and definitely an increased number of reversals.

The operating speed is an extremely important factor in producing effective motion of the pump plunger. Increased speed can produce more effective travel of the pump plunger. In general, the more effective plunger travel should help to increase the efficient operation of the pumping well. However, it is important that the plunger speed be slow enough so that the pump barrel can properly fill with the well fluid in the time available. This is dependent upon the character of the fluid, the restrictions through the pump valves, and the bottom hole pressure available. One investigator (Sargent)[2] made a study of the best maximum plunger speed for efficient filling of the pump, and concluded that the plunger should operate with a maximum of 660 inches per minute. Figure 9a is an example of a well where there is plenty of fluid available with a substantial pump submergence but which is being pumped with so much speed that there simply is not sufficient time for the pump to fill although the fluid is mostly salt water and not viscous.

With a given length of stroke, the number of strokes per minute defines the general pattern of the load characteristic at a given depth due to the effect of the harmonics of the natural vibration of the rod string. Under conditions of pumping where the well conditions are stable and there are no special fluid conditions or friction, the general pattern of the dynamometer cards adheres very closely to the analysis as shown by Slonneger.[3] Figure 10 shows a chart for determining the proximity to synchronous speed at various depths. Figure 6 shows the changing load pattern with speed constant and depth variable and operation near synchronous speeds.

Figure 7a shows a well which should have a load pattern close to a second harmonic and yet all of the natural rod vibration has been damped out due to the heavy viscous fluid being pumped.

Too often engineers or well testers who are new in analysis of pumping well problems feel that if they can just avoid synchronous speeds that their problem will be solved. Exact synchronous speeds are difficult to tune in on because it is difficult to regulate the speed of the prime mover with a fine enough adjustment. In the observation of many wells over the past 20 years, the author has tried to check the bad effects of synchronous speeds as shown by the abnormal load characteristic recorded by the dynamometer. Observation shows that there are many pumping wells that have been running at synchronous speeds over periods of years without any unusual trouble. On the other hand, Figure 11 illustrates a case where a synchronous speed should definitely be avoided.

Some synchronous speeds produce

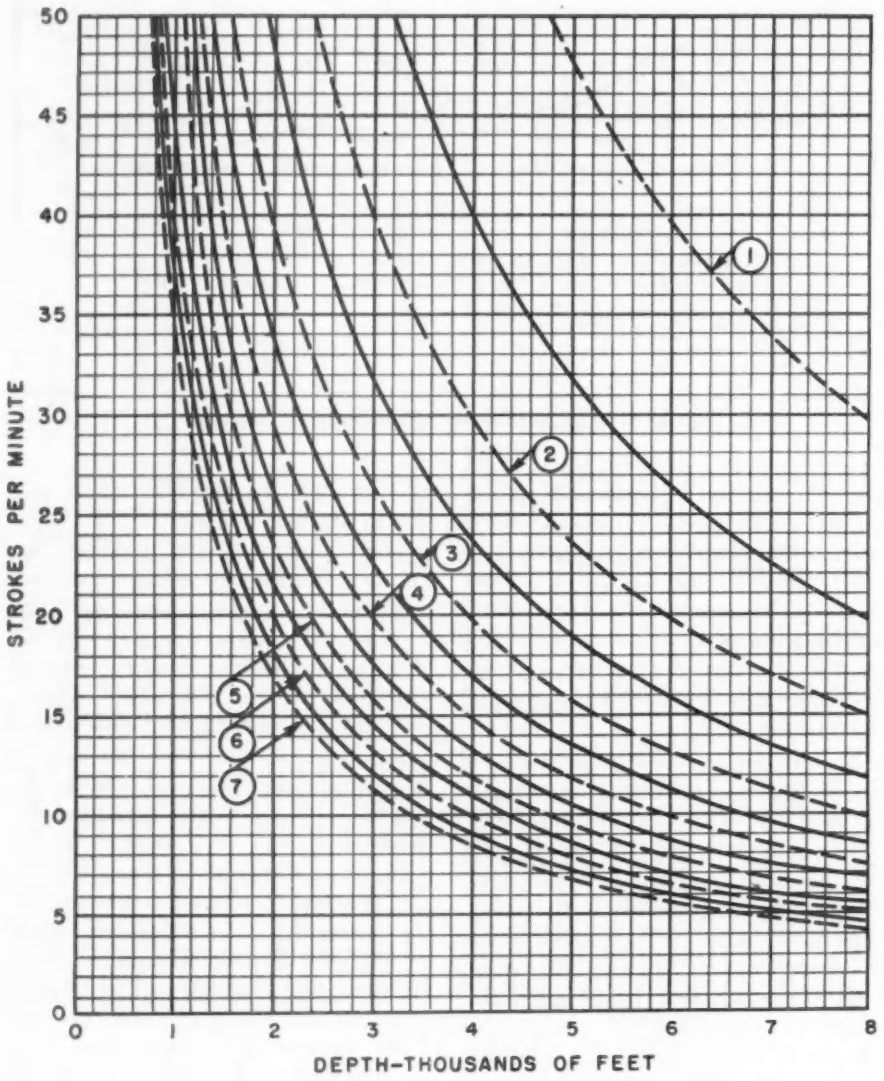


FIGURE 10—The above curves show the strokes which are in frequency with the natural period of rod vibration and the harmonics of this frequency. All are based on the relationship $F = \frac{23700}{D}$ where F = natural frequency of the rod string, D = length of the rod string. When the SPM of the pumping well equals this frequency the operation is at the first harmonic. When the SPM is one half this frequency operation is at the second harmonic speed. When the SPM is one third the operation is at the third harmonic, etc.

a load pattern which is quite difficult to counterbalance and sometimes adjustments can be made to get a more desirable load pattern.

The effect of the speed on plunger travel has previously been mentioned. There is no specific data available which can definitely say that the plunger travel is or is not more effective at or near some synchronous speeds. The second harmonic speed helps to give the most effective blow for cable tool drilling. From this it follows that operation at or near a synchronous speed may greatly affect the plunger travel.

If there were some method of getting a measurement of the true plunger travel at the surface of the well, we would have a much better method of determining just what is the best operating speed.

An increase in the number of strokes per minute may allow the use of a smaller prime mover to pump the well. The shorter, faster stroke cuts down on the peak torque and consequent peak horsepower requirement. This helps the prime mover but may be much more troublesome for the sucker rods and other equipment.

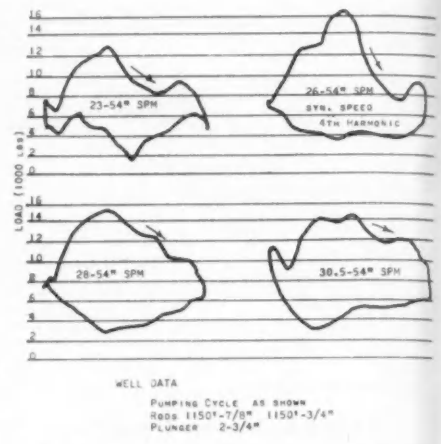


FIGURE 11—How operation at a synchronous speed produced an abnormally high load. Speeding the well up above 26 SPM decreased the load.

When a gas engine is used for a prime mover, care should be taken that it be operated at a speed which is in line with its design.

Speed has a definite effect on the amount of counterbalance effect when beam counterbalance weights are used, however, a counterbalance effect of rotary weights is effected very little by speed.

At high operating speeds the stuffing box friction can be a big factor in retarding the natural fall of the sucker rods.

Speed often results in excessive downtime because of equipment failures. More efficient production of the oil from any given producing formation can generally be done best by gentle removal, which means moderate speed. One major company has recently launched a program to definitely limit the operating speed of any individual pumping well based on the depth from which it is being pumped.

**Torque.** Mathematically expressed, torque is the product of the tangential force on a crank multiplied by the distance from the line of direction of this force to the center of rotation. It might be crudely stated as the amount of twist present at any moment on the crankshaft of a pumping unit. It is obvious that this torque changes continually in the operation of a pumping unit and reaches two peaks, one on the up stroke and one on the down stroke, going through zero at the extreme ends of the stroke.

If a pumping unit could deliver a continuous flow of horsepower the torque would be constant and would

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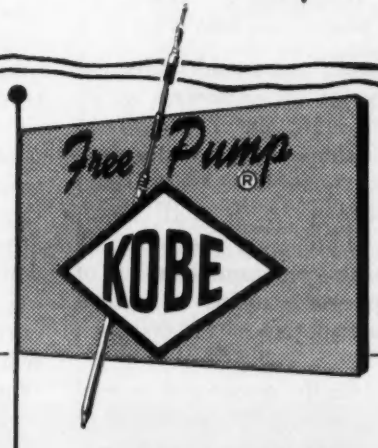


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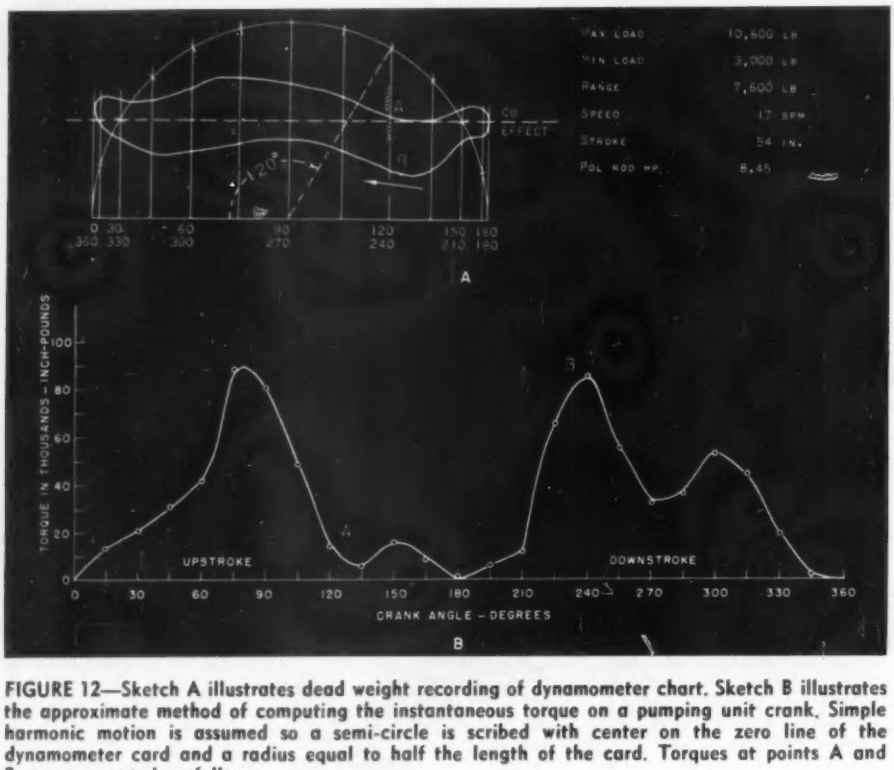


**FIGURE 12—Sketch A illustrates dead weight recording of dynamometer chart. Sketch B illustrates the approximate method of computing the instantaneous torque on a pumping unit crank. Simple harmonic motion is assumed so a semi-circle is scribed with center on the zero line of the dynamometer card and a radius equal to half the length of the card. Torques at points A and B were computed as follows:**

$$\text{Torque} = (\text{Load-CB effect}) \sin \theta \times \frac{\text{length of stroke}}{2}$$

| | POINT A (Upstroke) | POINT B (Downstroke) |
|---|---|---|
| Load (LB) | 7820 | 3720 |
| CB effect (LB) | 7400 | 7400 |
| Unbal. Load (LB) | 420 | —3680 |
| Angle of crank ($\theta$) | 120° | 240° |
| Sine | 0.866 | —0.866 |
| Torque (In.-LB) | 13500 | 86000 |

be expressed by the following relationship:

$$\text{Torque} = \frac{\text{Horsepower} \times 33{,}000 \times 12}{2\pi N}$$

If a pumping unit could be loaded to a steady 25 horsepower at 20 strokes per minute, the torque would be 78,700 inch pounds. At one time pumping unit gear boxes were rated on a horsepower basis and as an interesting comparison, the pumping unit which had a nominal rating of 23.1 horsepower also has to have a peak torque capacity of 114,000 inch pounds.

It was formally recognized several years ago that pumping units should be rated on a peak torque basis. (See API Proceedings[4] 1938.) The consideration of peak torque was illustrated through the use of a simple formula which was admittedly a very approximate and crude method. No attempt was made by any of the API committees to define just how this torque should be actually measured in the field.

There are only two spots on a pumping well installation which are readily available for the use of any type of measuring instrument. The output speed of the prime mover may be recorded by means of a recording tachometer, or the input to an electric motor, if a motor is being used for the prime mover, can be measured and recorded. The instantaneous prime mover speed will be affected by the instantaneous torque which is being applied to the pumping unit crank, and the instantaneous current taken by the electric motor will also tend to follow the torque requirements. Both of these measurements are definitely qualitative and do not give an index as to what the torque values are. It remains then that the only practical place to take a measurement leading to torque determination is at the polished rod with a polished rod dynamometer. By recording the polished rod load at all points of the stroke and then on the same chart recording the peak counterbalance effect, we do have a quantitative measurement which gives a method of determining approximate and accurate torque on the crank. This measurement should check the peak counterbalance effect given by the various pumping unit manufacturers on their own individual unit. For determination of the torque at all points of the motion, the best method is to work back from the instantaneous horsepower recorded at the polished rod.

In order to check the counterbalance effect with the dynamometer, the procedure is as follows: Stop the pumping unit with the crank and pitman at right angles to each other on the up stroke and set the brake. Then provide a chain to carry the difference between the dead weight of the rods and the counterbalance effect. Figure 12a shows this procedure. Release the brake and make a recording of the dead weight load on the dynamometer chart. This is the true measure of counterbalance effect at the polished rod. From this recording the approximate method of calculating torque is shown in Figure 12b.

It is well to check the counterbalance effect in the same manner, both on the up and down stroke, because the geometry of the pumping rig may make these forces quite different. When they are different the rotation of the prime mover should be in a direction so as to have the higher counterbalance effect on the up stroke and the lesser on the down stroke. When this is done, you actually provide a greater degree of counterbalance than in a case where the counterbalance effect is the same on the up stroke and down stroke. When an electric motor drive is used, the direction of rotation may make quite a difference in the power consumed.

The only other consideration of torque which is essential in a pumping installation is in connection with the prime mover. Engines are derated for pumping application to take care of the extra torque requirements, but the engine must be run at a near rated speed in order to give it a chance of good performance. An adequate flywheel can help the engine to meet peak horsepower and torque requirements on a pumping installation.

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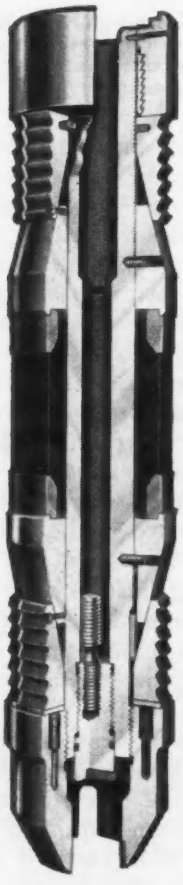

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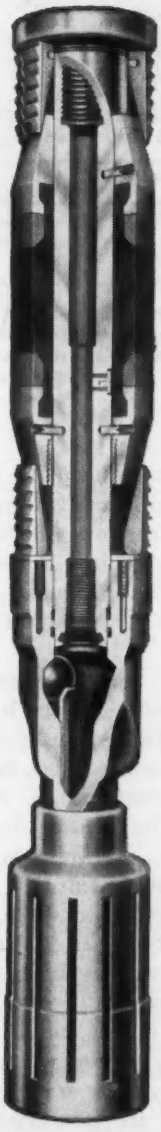

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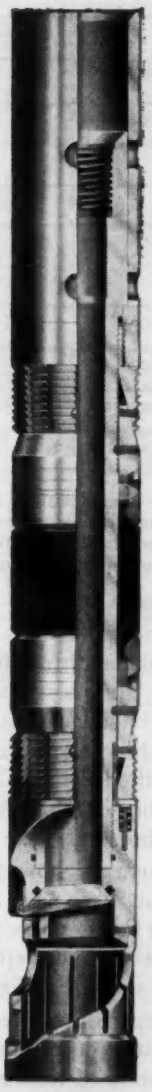

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| DEPTH | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 |
|---|---|---|---|---|---|---|
| PROD BPD 80% EFF | 1000 | 800 | 600 | 400 | 200 | 100 |
| PUMP SIZE | 2.75 | 2.25 | 2.25 | 1.75 | 1.50 | 1.25 |
| SPM | 15.3 | 18.3 | 13.7 | 15.2 | 10.3 | 7.5 |
| IMPULSE FACTOR | 1.24 | 1.34 | 1.21 | 1.24 | 1.11 | 1.06 |
| ROD SIZE | 7/8 3/4 | 7/8 3/4 | 7/8 3/4 | 1 7/8 3/4 | 1 7/8 3/4 | 1 7/8 3/4 |
| MAX LOAD | 14320 | 16160 | 18960 | 21100 | 20480 | 20350 |
| MIN LOAD | 3700 | 4030 | 6250 | 8450 | 11600 | 13870 |
| PEAK TORQUE | 196500 | 224000 | 235100 | 240500 | 164000 | 120000 |
| HYDRAULIC HP | 22.3 | 23.6 | 22.5 | 17.8 | 10.4 | 6.0 |

**FIGURE 13—Tabulation of torque requirements is based on calculations and shows the relationship between load, torque and hydraulic horsepower requirements when producing the approximate maximum practical production by sucker rod pumping. The working fluid level is assumed to be near the bottom. Note that shallowest wells have greater peak torque requirements than the deepest ones.**

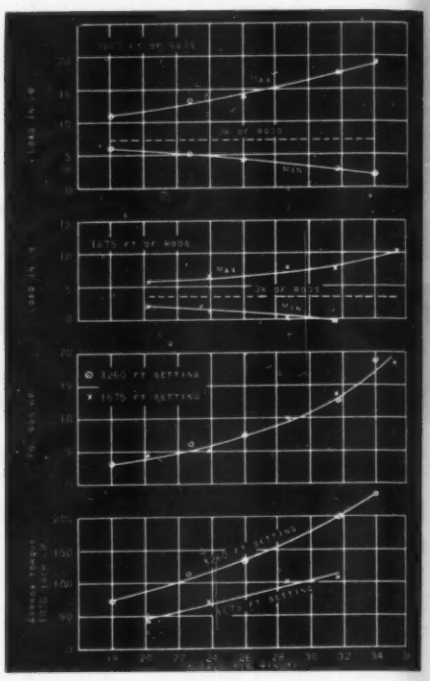

**FIGURE 14—Pumping a high fluid level—high productivity index well from two levels. Charts show the saving in load and torque requirements.**

of the torque throughout the pumping cycle, the most convenient way is to work backwards from the instantaneous horsepower requirements. This method will be fully discussed under the consideration of instantaneous horsepower.

To illustrate how torque requirements can vary greatly, calculations were made for wells pumping at capacity at various depths and the results are shown in Figure 13.

The depth of the well is no criterion for torque requirement, but rather the unbalanced load and this may be much greater for shallower high volume wells than for deep wells producing compartively small volumes of fluid.

**Horsepower.** In order to lift a certain weight of fluid a given number of feet in a given time, a very definite horsepower is required because the factors mentioned are in foot-pounds per minute, and we know that 550 foot-pounds per minute make one horsepower.

The hydraulic horsepower required to lift fluid from a well is expressed as follows:

$$HP = L\left[\frac{bpd \times 42 \times 8.34}{1440}\right] \times \frac{1}{33{,}000} = L \times 0.736 \times 10^{-5} \times bpd$$

Or it may be expressed as follows: HP = .000017 × bpd × psi, where bpd is "barrels per day" and psi the load represented by the net lift in feet. In order to get the true hydraulic horsepower, the working fluid level must be determined by measurement.

The theoretical hydraulic horsepower defines the basic power requirements necessary to pump the well. To this horsepower must be added all of the losses from the pump itself on up through the sucker rods back through the pumping unit, and through to the output of the prime mover.

In general, the prime mover horsepower is selected on the basis of 2 to 2½ times the hydraulic horsepower which is assuming the over-all efficiency to be between 40 and 50 percent. The horsepower load on the prime mover is cyclic in nature so the prime mover must be rated with enough excess capacity to take care of the peaks. With a single acting pump in service at the bottom of the hole, and nearly all sucker rod pumps are of this nature, all of the horsepower being expended to pump the well as far as the rods and bottomhole pump are concerned is being expended on the upstroke. In order to load the prime mover equally on the upstroke and downstroke, it is of course necessary to properly counterbalance the well. When a well is properly counterbalanced the prime mover is actually providing enough horsepower to raise half of the fluid on the upstroke and the other half on the downstroke. This is accomplished by storing enough energy in the counterbalance from the potential energy lost by the rods on the downstroke so that this energy will be available on the upstroke to help the prime mover.

It is common practice for electric motor manufacturers[5] to apply a cyclic load factor based on polished rod speed in selecting motors for pumping. An example of such a cyclic load factor is contained in the tabulation below.

In a similar manner the horsepower from a multi-cylinder or single-cylinder gas engine is derated to take care of the peak requirements of pumping wells.

The polished rod horsepower which is determined by measuring the area of the dynamometer card (this is a measure of the amount of work done per stroke) is a measure of what it

**Cyclic Load Factors for Normal-Slip and High-Slip Motors, With Rotary or Beam Type Counterweights**

| Polished Rod Average Speed—Inches per Minute (Stroke x SPM x 2) | Multiplier to Obtain Nameplate Horsepower from Average Horsepower | | | |
|---|---|---|---|---|
| | Rotary Counterweights | | Beam Counterweights | |
| | NS Motor | HS Motor | NS Motor | HS Motor |
| Up to 1500 | 1.10 | 1.05 | 1.10 | 1.05 |
| 1500 to 2000 | 1.20 | 1.10 | 1.20 | 1.10 |
| 2000 to 2500 | 1.30 | 1.15 | 1.40 | 1.25 |
| 2500 to 3000 | 1.40 | 1.20 | 1.55 | 1.35 |

From Westinghouse Bulletin B-4039 "Electrified Oil Well Pumping".

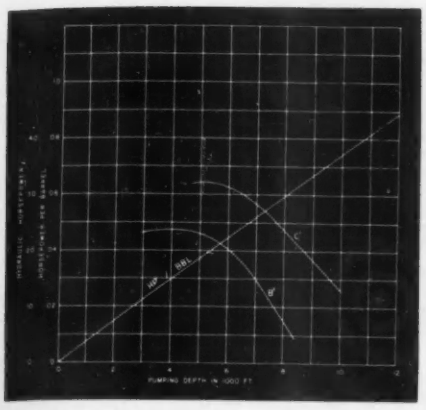

FIGURE 15—This set of curves shows the hydraulic horsepower required to lift the maximum practical production by sucker rods from the depths shown. This is HP output of bottom hole pump.

B'—Curve for pumping with maximum stroke of 74 inches.

C'—Curve for long stroke mechanical and hydraulic pumping units. Maximum stroke considered 240 inches.

is actually required to pump the well.

A well in Kansas was at one time pumped with a full string of rods and a half string of rods and Figure 14 shows that the horsepower requirement as measured by the polished rod was identical showing that it is the net lift which is important. Note that the peak loads and torque requirements were quite different, however. The polished rod horsepower may be less than the hydraulic horsepower if the well is semi-flowing. It may be abnormally large when the well is pumping too fast or has excessive friction. A comparison of the polished rod horsepower with the theoretical hydraulic horsepower will give an index of the downhole efficiency.

It is interesting to stop and analyze just how much horsepower may be transmitted by a string of sucker rods. To do this, a set of curves was plotted from data collected over the last 20 years, showing the maximum volume of fluid produced successfully from a given depth (Figure 15). The term "successfully" means that the wells were operated with a moderate amount of mechanical trouble. Care was taken to choose only wells where the operating fluid level was known to be near enough to the pump so that the net lift would be from near the bottom of the well.

From this set of data, it is quite evident that the peak horsepower that it is possible to transmit by sucker rods is at the depths between 4000 and 5000 feet. Below 5000 feet the limit is set by the size of the plunger which it is possible to use and the plunger speed.

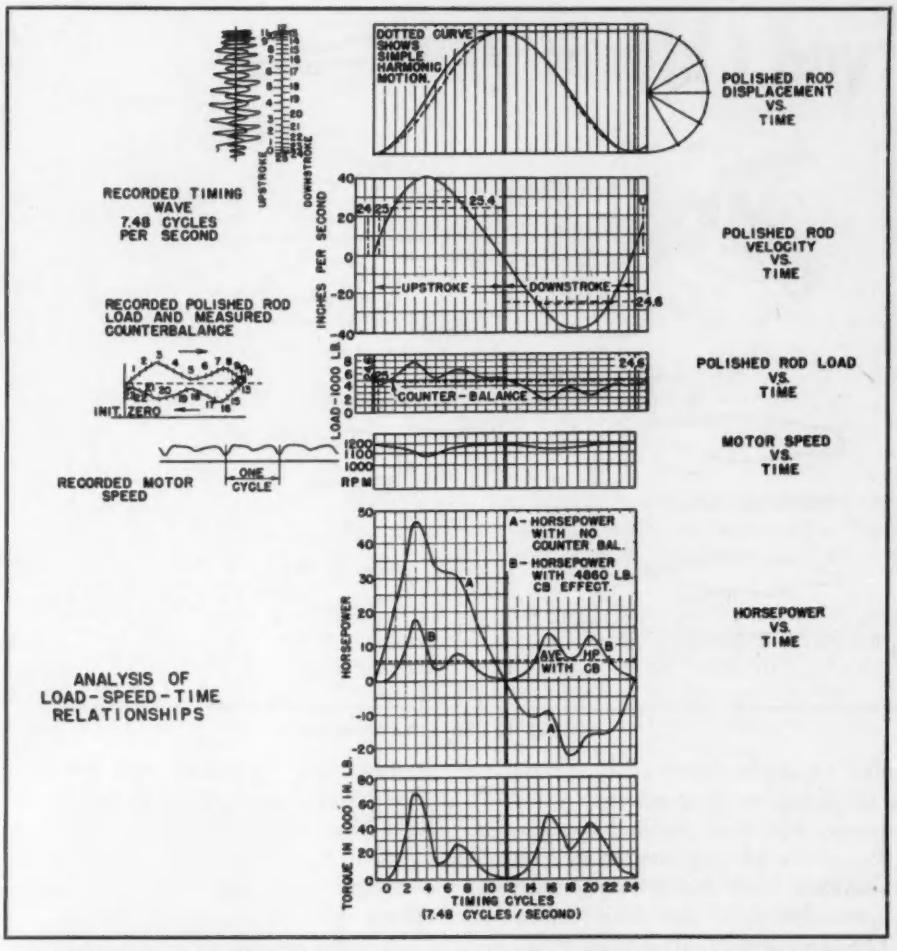
DOTTED CURVE SHOWS SIMPLE HARMONIC MOTION.
POLISHED ROD DISPLACEMENT VS. TIME
RECORDED TIMING WAVE 7.48 CYCLES PER SECOND
UPSTROKE
DOWNSTROKE
INCHES PER SECOND
23.4
24.6
POLISHED ROD VELOCITY VS. TIME
RECORDED POLISHED ROD LOAD AND MEASURED COUNTERBALANCE
INIT. ZERO
LOAD - 1000 LB.
COUNTER - BALANCE
POLISHED ROD LOAD VS. TIME
RECORDED MOTOR SPEED
ONE CYCLE
RPM
MOTOR SPEED VS. TIME
ANALYSIS OF LOAD - SPEED - TIME RELATIONSHIPS
A - HORSEPOWER WITH NO COUNTER BAL.
B - HORSEPOWER WITH 4000 LB. CB EFFECT.
HORSEPOWER
AVG. HP WITH CB
HORSEPOWER VS. TIME
TORQUE IN 1000 IN. LB.
TIMING CYCLES (7.48 CYCLES / SECOND)

FIGURE 16—Kinematic analysis showing how instantaneous polished rod position and load may be translated into instantaneous HP and torque.

When it is desired to compute the horsepower of a jet airplane, the foot-pounds per second is computed from the product of the thrust (pushing force measured in pounds) and the speed of the airplane. The horsepower being expended by a train locomotive at any given time is determined from the product of the draw bar pull in pounds and the speed at which the train is traveling.

The polished rod dynamometer records the instantaneous load for all points of the polished rod stroke. Also on the dynamometer a timing bar is provided which records a damped cyclic wave showing the position of the polished rod at equal intervals of time. From this wave the instantaneous velocity of the polished rod is readily computed and a curve may be drawn showing the velocity at all points of the stroke. With the same timing wave, the load curve may be broken up into equal time intervals and replotted on a time basis. From these two curves the instantaneous horsepower may be computed. This curve takes into account the degree of counterbalance because it is the unbalanced load which is used to get the true horsepower curve. Such a curve re-emphasizes the need for proper counterbalancing.

The replotting of the load curve on a time basis also provides a much clearer picture of the natural vibration of the sucker rod string and greatly helps in understanding why a dynamometer card assumes the shape that it does.

Going back to the relationship shown under the heading "Torque," we can now use this expression to determine the instantaneous torque at the crank. It is only necessary to know the instantaneous speed of the crank and this is obtained by taking a recording tachometer curve on the prime mover. In doing this the top and bottom of the pumping stroke should be carefully marked on the tachometer chart and the timing pen should be in operation so that the speed variation can be plotted against time.

Figure 16 is an example of how this analysis is supplied. This partic-

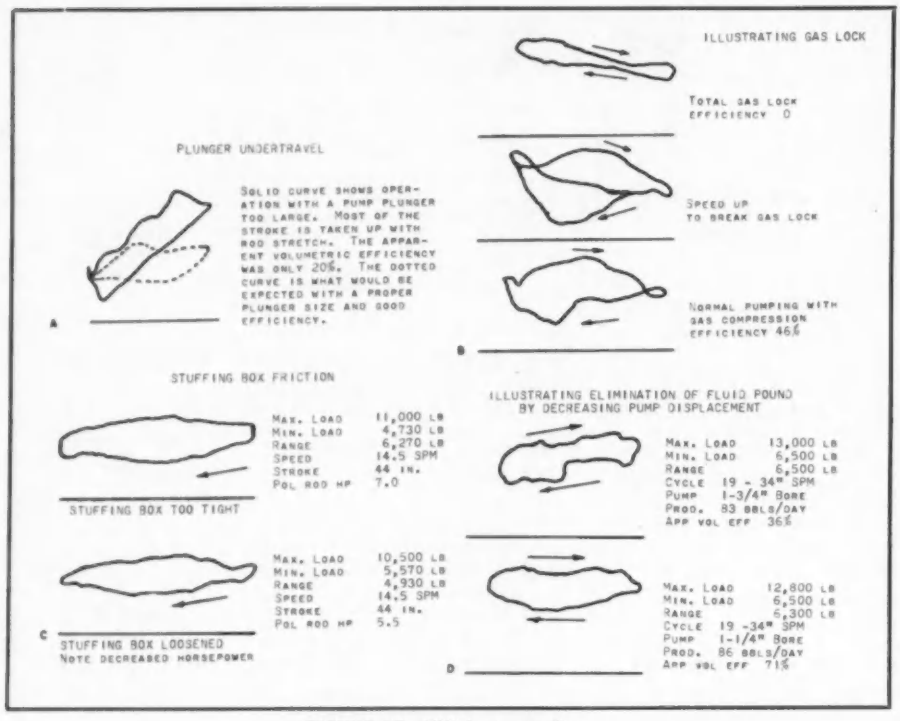
PLUNGER UNDERTRAVEL
Solid curve shows operation with a pump plunger too large. Most of the stroke is taken up with rod stretch. The apparent volumetric efficiency was only 20%. The dotted curve is what would be expected with a proper plunger size and good efficiency.
A
STUFFING BOX FRICTION
Max. Load 11,000 lb
Min. Load 4,730 lb
Range 6,270 lb
Speed 14.5 SPM
Stroke 44 in.
Pol Rod HP 7.0
STUFFING BOX TOO TIGHT
Max. Load 10,500 lb
Min. Load 5,570 lb
Range 4,930 lb
Speed 14.5 SPM
Stroke 44 in.
Pol Rod HP 5.5
C
STUFFING BOX LOOSENED
Note decreased horsepower
ILLUSTRATING GAS LOCK
Total gas lock efficiency 0
Speed up to break gas lock
Normal pumping with gas compression efficiency 46%
B
ILLUSTRATING ELIMINATION OF FLUID POUND BY DECREASING PUMP DISPLACEMENT
Max. Load 13,000 lb
Min. Load 6,500 lb
Range 6,500 lb
Cycle 19 - 34" SPM
Pump 1-3/4" Bore
Prod. 83 BBLS/DAY
App vol eff 36%
Max. Load 12,800 lb
Min. Load 6,500 lb
Range 6,300 lb
Cycle 19 -34" SPM
Pump 1-1/4" Bore
Prod. 86 BBLS/DAY
App vol eff 71%
D

**FIGURE 17—Efficiency studies.**

ular example shows a dynamometer card taken at a speed that produces a card which is pinched together at the center part of the stroke. This is a natural load characteristic with the operation near the fifth harmonic. The pinched-down section near the middle of the stroke shows very little unbalanced load at that point, hence it might be assumed that the peak torque is low. However, due to the rig geometry the product of velocity and load is greatest at a point approximately one-fourth of the upstroke travel. This is a case where any approximate method of computing torque is greatly misleading.

**Efficiency.** After a pumping installation is made, every effort should be made to see that it is oprating efficiently. Consider first, the apparent volumetric efficiency which is the ratio of the actual production to that which would be theoretically produced if the pump plunger is moving the same distance as the polished rod and with the added requirement that the pump barrel is filling completely on each stroke. The apparent volumetric efficiency can vary from over 100 percent to a low figure, depending upon the well conditions and the character of the fluid being produced. The tendency on any well running with a low efficiency is to speed the well up to try to get more production to make up for the low efficiency. This means unnecessary loading on the equipment and subsequent fatigue of rods and possibly unit trouble. Marsh[6] discussed the attainment of high volumetric efficiency as far back as 1931 and yet today many wells are operating with very poor efficiency.

In order to correct low volumetric efficiency, it is necessary to look at all of the factors which may cause it.

If any pump plunger is unnecessarily large, the result will be a plunger undertravel, (see Figure 17a) which means that a great portion of the stroke is wasted because of rod stretch. The pump plunger size should be selected according to the depth and the volume which is to be produced.

When gas is being produced with the fluid, the result is often a partial gas-lock (Figure 17b) of the pump causing low volumetric efficiency. An attempt should be made to separate the free gas from the fluid by means of a gas anchor if this is practical. However, the gas anchor should actually separate gas and fluid and not just act as an added restriction in the bottom of the well. In order to do this, the velocity down inside of the gas anchor must be slow enough so that rising gas bubbles can escape, without being drawn into the pump. A gas anchor of this type is shown in Figure 18.

When the gas is, for the most part, in solution in the oil under bottomhole conditions, then every attempt should be made to pump the well to

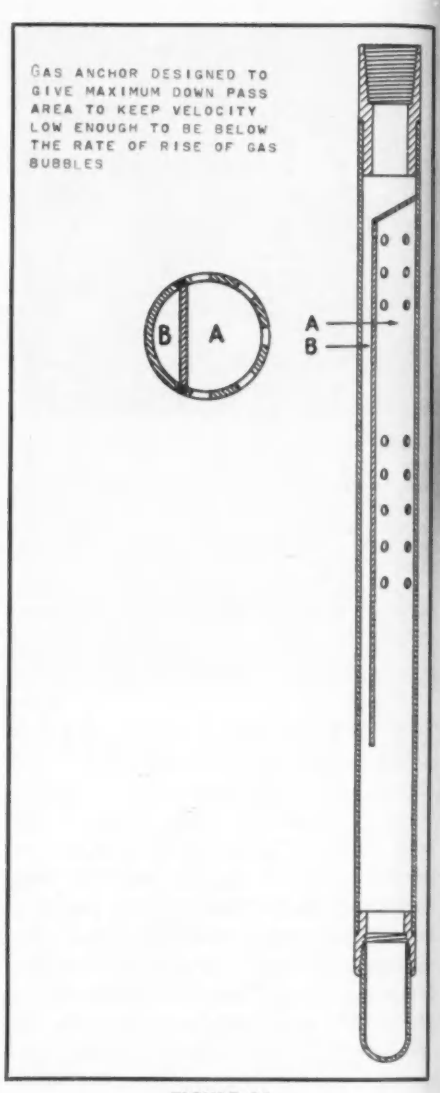
Gas anchor designed to give maximum down pass area to keep velocity low enough to be below the rate of rise of gas bubbles
B
A
A
B

**FIGURE 18**

prevent, as much as possible, the gas coming out of solution until after it has passed through the pump. There have been several cases where the raising of the pump several feet off bottom has resulted in increased production in such a well. This procedure provided sufficient back pressure on the formation so that the gas would not break out of solution back in the formation and prevent solid fluid from reaching the pump. This type of well can be very easily pumped too hard and much can be done to improve the efficiency.

High apparent volumetric efficiencies are harder to obtain as wells go deeper. The chief reasons for this are that more lost motion results from stretch of rods and more gas is in solution due to the higher bottomhole pressures which means greater shrinkage of fluid volume. Lost motion due to tubing travel is also a big factor when no tubing anchor is used.

The loss of stroke due to the stretch of sucker rods and the stretch and

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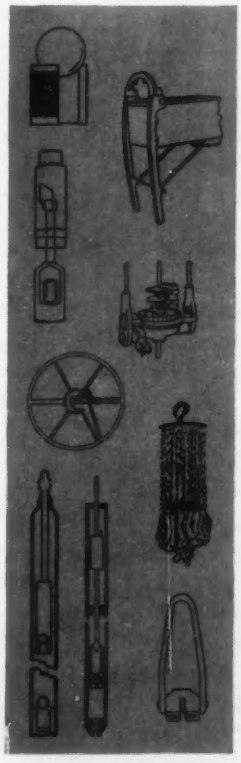

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motion of the tubing was recognized by Marsh.[6] This lead to subsequent studies of plunger motion and tubing motion and the establishment of several empirical formulas. All of these were important contributions and serve to indicate what can happen at the bottom of the well, but does not give an easy solution to what is actually happening in a particular well. If a simple means could be provided to give an indication of actual plunger motion at the top of the well, then some real progress could be made in the selection of the pumping speeds.

The bottom-hole pump should at all times be submerged sufficiently to allow a full filling of the barrel. When such is not the case, the common fluid pound (Figure 17d) is the direct result and a fluid pound does nothing for a pumping well except to cause unnecessary wear and to introduce shock loads to the sucker rods and related equipment. Such a well simply cannot be counterbalanced properly.

The plunger speed may be too high to allow the filling of the pump barrel in the time allotted. Figure 9 is an example of a well with sufficient fluid but which is operating so fast that the pump barrel just does not have time to fill and a fluid pound results.

When pumping fluid which is fairly viscous it is quite easy to adopt a speed which will result in a fluid pound even though there is sufficient fluid available. In cases of this type often an increase in the size of the pump valves can greatly help to increase efficiency and production.

When a well pumps off and it is found necessary to keep it pumped off, every effort should be made to regulate the speed so that any indication of fluid pound comes very shortly after the beginning of the downstroke when the velocity of the plunger is the least. Many wells are being run on water-flood operations with specific instructions to keep them pumped down. Too often if instructions are given to keep the well pumped down, the pumper likes to have the pound occur near the middle of the stroke so there will be no question about the well pumping off.

Pumping efficiency can, of course, be greatly impaired by abnormal and unnecessary friction factors. A tight stuffing box can cause considerable loss of power, as illustrated in Figure 17c.

Often in an attempt to improve the pumping efficiency of the bottom-hole pump, the tubing is anchored so as to prevent its motion. Generally motion of the tubing decreases the effective travel of the pump plunger. However, in many cases it has been brought to light that if too much load is put on the tubing anchor, the slack in the tubing may cause unnecessary loading on the rods which actually defeats the purpose of putting in the tubing anchor. Although the load may be set correctly to start with, the pumping motion itself may have a tendency to make the tubing anchor crawl due to the transfer of the fluid load from rods to tubing and back on every pumping cycle. The setting of the tubing anchor requires the use of an accurate weight indicator so that there will be a very definite indication of how much load is being put on the anchor. Also it is considered good practice to install sufficient tubing below the anchor to equal the amount of the fluid load so that the transfer of the load on each pumping cycle will not relieve the force holding the tubing anchor in place. Tension type tubing anchors and hydraulic types present other problems, but all are designed to prevent tubing movement.

The efficiency of a surface pumping unit from prime mover input into polished rod may be checked when suitable instruments are available to measure the prime mover input or output. In the case of electrified installation, this is compartively simple, but for the gas engine installation it presents quite a problem.[7]

For maximum efficiency, the pumping installation should be definitely tuned to the ability of the well itself to perform. There is a very definite tendency to overproduce most wells, and particularly those which are not pro-rated. Even with the pro-rated wells, there is a great tendency to try to get more out of the well than it is capable of giving up and then getting into considerable trouble with equipment.

Some wells of course need to be operated intermittently in order to give the best efficiency. These are the wells where there is a comparatively tight formation and where a build-up of fluid level does not greatly retard the flow of fluid into the well bore because there is sufficient bottom-hole pressure. If a well like this is operated continuously, a pump-off condition is sure to result.

Intermittent pumping is used also to save in the power requirements necessary for the operation of the lease. This is particularly important when purchased electric power is being used. By using the proper type of recording electrical demand meter, the very best pumping cycle for the intermittent type of well may be accurately determined.[8]

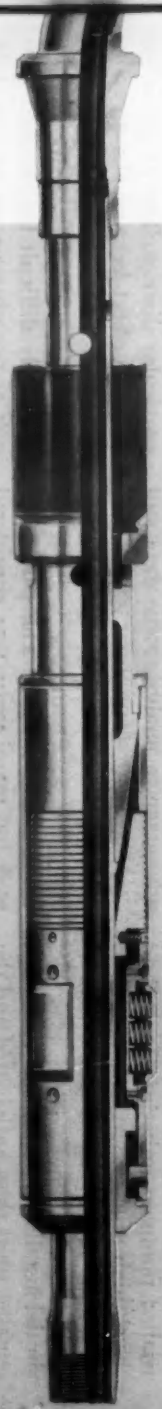
When free gas is causing low pumping efficiency in the well, corrective measures can often be made on the well itself to cut down on the gas-oil ratio. It may be that the production rate is so high that the gas-oil contact has been pulled down below the level of the casing seat. It may also be that the well was not completed properly in the first place.[9]

The problem of paraffin deposit in tubing may be remedied by one of several ways. Paraffin scrapers may be installed on the rod string to continually cut loose the paraffin, chemical solvents may be provided, heated fluids may be pumped down through hollow rods, and some good results have been obtained by the use of plastic coated tubing, which prevents deposition of the paraffin. Sometimes in treating wells for paraffin deposits, it is necessary that bottom-hole heaters be put in service to prevent the deposition of paraffin at the well bore, and consequent stoppage of free flow into the pump.

The type of pump which is used in individual pumping wells is important and no detailed attempt will be made here to pick the pump for an individual pumping well. There have been some very good papers written along this line. Because of the large variety of pumps and pumping arrangements available, it is a logical conclusion that pumps are developed to meet particular conditions found in various wells. Two of the newer developments might be mentioned; one is a ratio compound pump designed to improve the filling of the barrel under gassy conditions, and the other is a double displacement pump designed to allow a higher volume of fluid to be produced through a given size of tubing. The latter type of pump is particularly useful in some of the water-flooding operations.

Some work has been done with a so-called bubble point pump[10] to combat the practice of overpumping a well and pulling solution gas out and

# DOWN



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gas locking the formation and pump. The principle of this pump was simply to provide a very large clearance volume in the pump. This procedure has actually resulted in increasing the productivity index of the individual wells.

## BACKGROUND OF PUMPING WELL

In order to have a full 3-D picture with all of it in focus on the equipping, operation, and maintenance of pumping wells, it is necessary that there be a program well understood by all of the various personnel involved if good results are to be obtained. The duties of individuals involved must be defined, procedures outlined, and a program carried out. When trouble has developed very little real progress can be made in improving the operation unless everyone understands the problem and is willing to cooperate.

The management of wells about to be put on the pump must understand that the initial selection of equipment should be based on the known facts about the reservoir as gathered by the reservoir engineer. These facts may in turn be given to the engineer responsible for selection of equipment so that he can make proper equipment selection.

Top management knows that to determine the potential production from a well the reservoir engineer must be guided by the use of various instruments and services. Thus, through measurements of down-hole conditions by electric logs and radioactive logs together with core analysis, fluid analysis, and bottom-hole pressures, etc., the data is provided to estimate what the well will produce. Build-up curves and productivity indices of individual wells, during their flowing life or early pumping life, are attained.

If intelligent use of all data is not made it is possible that the wells may be improperly equipped.

The intelligent use of reservoir data and dynamometer data is covered in the following outstanding example: One major company in Canada installed pumping units in a high fluid level, high productivity index field, on the basis of data which was gathered in Kansas on a similar type of well. The initial installation was made with much smaller units than anticipated and the wells were set to pump with the pumps only half way down in the well. The other companies in the same field designed all of their installation on the assumption that these wells would pump from bottom with considerably higher volumes of fluid. This is a case of applying good reservoir and dynamometer data to an initial installation and in this particular case, $80,000 was saved by the initial pumping equipment alone. This was done some five years ago and a recent check showed that this equipment was all running very well.

After a pumping installation is properly installed and adjusted, then its operation and maintenance should be in line with that used in the careful handling of a safety program. Wells should be studied first to ascertain just how the various components of equipment are being loaded in relation to their capacity. A careful set of records on the pumping well should be set up so that all the information is in one spot.

It is important in getting ready for a dynamometer study of a well to get all of the data and any past history of the well together, so that the real reason for making the test may be readily understood. Many times the field foreman and superintendent feel that there should be so many wells weighed in a particular day. It is not a question of how many wells can be weighed in a day but that considerable thought should be given to the individual well to know what is the best procedure concerning it.

All too often the dynamometer study is carried out by the very newest engineers in the company, and as soon as they understand just what they are trying to do they are shifted off to some drilling operation. The next batch of engineers coming along do not have a complete record of what the others have tried to do and start all over again. For this reason the best procedure in keeping a pumping well program operating, is to put the actual field measurement in the hands of non-technical personnel who will remain in the area and keep the program moving. The engineers will then be used to best advantage in analyzing the data and making recommendations.

The pumper's responsibility in the operation of a pumping well should be carefully defined. The pumping well for many years was considered an operation that could very well take care of itself. After the initial installation and a few adjustments, the operation was left to the pumper.

The pumper's knowledge of mechanics was for the most part very limited. He was told that his job was to see that the stuffing box didn't leak, that the various parts of the unit should be lubricated when they needed it, and that when something went wrong he should go to the nearest phone and report it.

Only when something went wrong which was not easily corrected by the field personnel, was an engineer called in on the job. The engineer was used strictly to try and straighten out trouble which had already developed. The first need in this type of program is to provide instruments to measure and know what is going on. The polished rod dynamometer, the recording tachometer, the indicating ammeter, and later on the fluid level measuring device, came into common use. However, there are many, many instances where the pumper is never informed as to just what is being attempted, and he felt that any time an engineer got near his well it meant a little bit of lost production for him.

In spite of the fact that there are many instruments and procedures available and that these have been written up from time to time in technical papers and articles for the various trade journals, many pumping well areas are allowed to grow as best they can.

The use of the dynamometer originally came about in a study of the breakdown of equipment. The engineer and the instrument were used to go out and put out a fire rather than try to eliminate the cause of the fire. This is the most difficult part of the program of pumping well operations. The best results and those you can least show economic figures to substantiate is a program of preventive maintenance on pumping well operations.

The old method of pumping well operation can best be illustrated by the story of one major producer, who instituted a comprehensive program on the study of pumping wells in a particular district. The program was put into effect because the operating costs were getting too high.

Even under these conditions it was extremely difficult for the headquarters engineering personnel to sell the management on putting the program

into effect through the use of field engineers on pumping problems alone. There was the usual reluctance to change in the area by the field foreman and the various pumpers, because they had already been doing things in what they thought was the best manner for some 20 or 25 years.

The real result from this program is phenomenal. By carefully studying pumping wells to improve their operation, many things were done. Speeds and strokes and pump sizes were adjusted on individual wells, some marginal wells were brought back to economic operation through the use of larger pumping units, rod and pump failures were studied, and when corrections were made, 4 out of 7 full time pulling units were retired from service. The actual operational saving in the first two years amounted to approximately $180,000. The economics of this program is easy to see, but if the pumping wells had been subject to studies and a program put into effect many years before, a much greater saving would have resulted but it would have been difficult to prove.

Another major company has instituted in the last five or six years a very comprehensive program on the operation and testing of pumping wells. This program has in general lead to the use of one size smaller pumping unit than previously was selected for a given job. This is a direct result of continued attention to the loads, counterbalancing, and the efficiency of operation of individual units. The standardization of a sucker rod size and type program for this company has resulted in the saving of some $6000 per month in their warehousing costs alone.

When complaints are sent in on the operation of field equipment for this company, the dynamometer cards and other data must be presented which will substantiate the assumption that the equipment was at fault. Under this program sucker rod complaints have been virtually eliminated, and as one headquarters man relates it, he has ceased to see any really bad dynamometer cards because the field makes such adjustments as should be made before sending them in.

The progress that this company has made has only been attained through a full understanding by all of the various field personnel involved, of what the program is and what they are trying to do. This company now has an observer stationed at individual wells when the well is serviced by outside servicing companies to see that their practice in handling of rods and tubing, and their general procedure is in line with accepted standards by the company. If the crew is caught pounding on sucker rod couplings, they are instructed to remove the coupling and install a new one.

Several years ago one field foreman in Kansas made a very comprehensive study of the operating efficiency of the various pumping wells. He was concerned only with the apparent volumetric efficiency of the pump. He accordingly changed pump sizes and raised and lowered pumps to increase efficiency and through this procedure alone he was able to cut the sucker rod failures from one a day to one a month in this particular district. This was a case where the field foreman himself actually was responsible and did the work without the help of the engineering department.

Many times corrective measures are needed on pumping wells and there are just so many other things to do that the operating personnel put it off until the very last. In other words, since there is no complete breakdown there seems to be no need for the operation.

A very careful analysis of records showing the operation of the equipment and the well itself can often lead to corrective measures for the well. It would be extremely helpful if a sick well fund were set up by each individual company so that there would be no continued argument as to whether some money should be spent to improve the operation of a dwindling pumping well. Oftentimes just a cleanout will produce a phenomenal result in the operation of an individual well.

The cost of pulling a well can run from $100 to $1000 just to repair rods or replace a bad pump. Doesn't it make good sense to check the pump in the well to see if trouble can be diagnosed before the pulling unit is called.

Flexibility must be provided in any pumping well program so that, if fluid conditions change or are not as anticipated, equipment can be moved and replaced with some of more appropriate size.

Sometimes engineers and field men seem to be working at cross purposes. The best results as far as the study and operation of pumping wells is concerned has been obtained when the actual field work of taking dynamometer cards, measuring fluid levels and making individual well tests is done by non-technical men. Some compenies call these men engineers' assistants and others call them well testers. These men are assigned to certain districts for long periods of time and thus get to know the characteristics of individual wells more intimately than the engineers do when running only occasional tests. This helps to keep the whole program moving.

It is becoming more and more evident that the life of the individual pumping well is becoming more and more important. Wells should not be abandoned prematurely because of unnecessarily high pumping costs. In order to meet the increased demands of daily production of petroleum, every barrel that can be obtained economically must be produced. To abandon a pumping well prematurely means lost production that can never be regained.


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**ACKNOWLEDGMENT**

The general theme of this paper was originally given at the West Texas Oil Lifting Short Course held April 21-22, 1955. This article is an expansion of that theme. In addition to the special references given above, there were many other sources of information.



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# How to Sell Corrosion Control to Management

**Use the dollar sign and not technical data. Here's how Sun Oil Company's corrosion engineers put their program across.**

**By J. C. SPALDING, JR.,** Sun Oil Company, Dallas

WHEN ATTEMPTING to prove to management the high costs of the ravages of corrosion accurate servicing and equipment cost records are essential. However, the presentation of this data to management should be revised and interpreted in terms of the actual money earned or money saved the company by the installation of proper corrosion control methods.

Every good salesman knows that in order to sell something there must be a product. The better the product the more sales—or is this really true? Does the salesman who has the best product always make the biggest sales? An affirmative answer to this question is very doubtful but a product is essential before a selling job can be done.

The product in question here might be classed as an intangible as opposed to a tangible item such as a pumping unit, a piece of pipe, or a rectifier. This fact immediately complicates the job of selling because there is no model with which to present the customer, with which to demonstrate the product's workability or functions. However, this is not an insurmountable problem because other products, in other lines, are intangible, viz: securities, annuities, life insurance, etc. In other lines salesmen use various techniques to sell even tangible products that have little to do with function or operation of the item, viz: color scheme in automobiles, design in clothes, etc.

From the above it can be seen there are many approaches to this game of selling. For instance, one great salesman once said "don't sell the steak, sell the sizzle." As remote as it may seem, this little cliche has a close application to the subject in question here. By this it is meant that, is the problem one of selling corrosion control to management? Or is the actual problem (or product) one of selling the results of corrosion control—monetary savings?

As peculiar as this may seem, with all of their experience and their intelligence, it would seem that most people in management have a one track mind. This track is composed of the two vertical bars in the dollar sign; they are interested in money. Of course, as an engineer, the corrosion technologist is often interested in things other than just money, within the field of technical science. Management is not. Its job is money and as long as operations keep within the limit of the law and within their own limits of ethics and at the same time make money, management is satisfied.

**Four Steps.** H. L. Bilhartz of Production Profits, Inc., Dallas, recently reported on the status of corrosion control before the AIME in San Antonio, Texas, and said that there were four steps in corrosion control:

- Awareness of problem
- Research into fundamentals
- Application of technology
- Evaluation of results (dividends)

The first three of the above are of a technical and operational vein and will be disregarded for the time so that Step 4 may be concentrated upon since this is the step in which management is most interested.

The above point is stressed in order that the problem of selling corrosion control to management may be approached from the right angle, that is from management's angle, the monetary savings point of view. This point should be impressed particularly upon the younger engineers starting in the field of corrosion control—

*"Do not try to impress management with a technical presentation of corrosion control."*

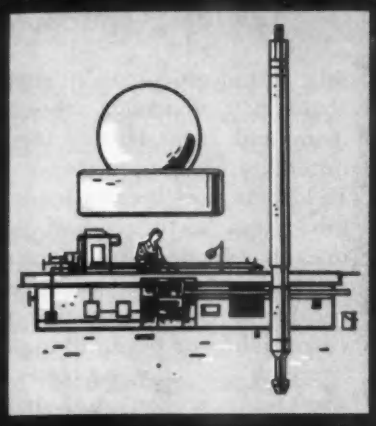
By this it is meant that talk in terms of pounds of iron saved per day, tons of steel saved per year, savings of natural resources, reduction in penetration rates, etc. is of no particular interest "per se" to management. For instance if it were cheaper to replace a pipe line because it corroded out than it is to use corrosion control methods, management would replace said line periodically rather than embark upon a corrosion control program. Similarly, if it were just as cheap to replace sucker rods and pumps in oil wells every six months as it is to apply corrosion inhibitors, management would have no particular reason to apply corrosion inhibitors to oil wells.

Probably this one feature of selling corrosion control to management has been the stumbling block to more corrosion engineers than any other one. It has been found that corrosion control can be sold to management through the use of records, analyses and calculations that demonstrate positive monetary savings.

**Case History.** Here briefly is a history of corrosion control in the Southwest Division of Sun Oil Company.

Back in 1945 and 1946 one of the major companies published the fact that formaldehyde could be used to inhibit the extreme corrosion rates found in sour crude wells. The chief chemist of Sun Oil Company read of this and talked management into trying formaldehyde on two very troublesome wells in the Howard-Glasscock field in West Texas. Records kept on these wells indicated that the rods had been pulled as frequently as every other day and 8 to 10 rod jobs per months were commonplace. Formaldehyde was used on these wells for one year and still rod jobs continued.

Because of this fact, management took rather a dim view of corrosion inhibition. What they did not realize and what the engineering personnel failed to emphasize at this time was that there was a definite decrease in rod jobs. This decrease in rod jobs



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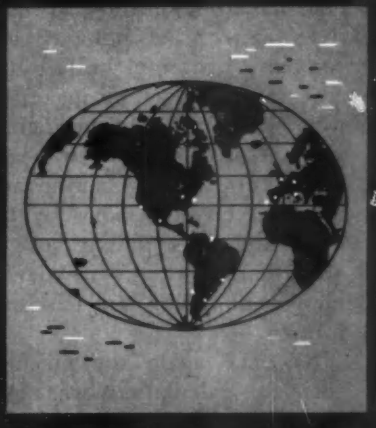

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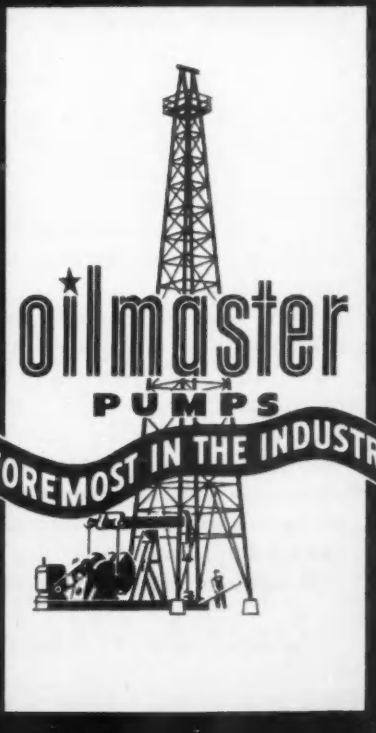


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definitely paid for the amount of chemical that was used but the chemical was unpleasant to handle, personnel complained, and the corrosion inhibition program was in serious jeopardy of being discontinued.

About this time an organic chemical was marketed by a chemical manufacturing concern. The corrosion control program was switched to this chemical and it was not only comparable to formaldehyde but gave superior results. Rod jobs were practically eliminated, however management was still not too impressed.

Based upon the monetary savings for three years on these two wells permission was obtained to extend the program to a limited number of other wells. The figures presented to prove the monetary success showed that in one year's operation with no treatment the cost to produce the oil from these wells was over 26 cents per barrel in direct corrosion costs. After using formaldehyde for one year these direct corrosion costs had been reduced to 18 cents per barrel and after using the organic inhibitor the total direct corrosion cost was 4 cents per barrel. For one year's operation it was demonstrated that the monetary savings in direct corrosion costs amounted to some $5800 on two wells.

As a result of the above figures being presented to management, in 1949, as an example of what could be done with corrosion control in sour crude areas, authorization for a 20-well program in four West Texas fields was given. The program was to last one year and costs were carefully kept during this time by engineering personnel and in 1950 the result of this test was shown to have saved approximately $5000 on these additional 20 wells.

Presentation of the above figures was encompassed in a formal report in which all corrosion costs were listed and itemized. Care was taken to include the cost of corrosion inhibitors as well as material replaced and labor costs. As a result of this report the engineers were given a go-ahead signal to treat all wells in which corrosion mitigation seemed feasible.

The decision on which wells to treat was based on a criteria of corrosion costs incurred in producing wells. If corrosion costs for a 6-months period on a well ran above $1 per day it was felt that this could be reduced by the use of corrosion inhibitors. This was based on the fact that the average corrosion inhibitor cost was approximately 50 cents per day and practically all service jobs due directly to corrosion were eliminated.

**Program Expanded.** Since 1950 the corrosion control program has been expanding from the above area to all areas served by the company's operations. Technology has advanced to the point where an attempt is made to prevent corrosion before it gets too far advanced rather than waiting until equipment failures and service charges indicate sufficient cost to warrant corrosion control. In order to accomplish this, another "selling job" was necessary.

Of course, the first hurdle was over, management had been convinced that where corrosion did exist, monetary savings could be made by a corrosion control program but this had only been proven in the obvious cases. It had been proven, only by a demonstration to management, that corrosion does cost money. In order to prove this point to management, engineers went into the field and sought out corrosion, looked in junk piles, examined records, kept accurate tabulations of service jobs in all areas, etc. When an engineer noted that service jobs on any given well became excessive (approximately more than four per year) the causes of such service jobs were investigated. Often the report came from field personnel that equipment had been replaced because it "wore out." This type of report then made it necessary for the engineers to discern between equipment that has just plain worn out and equipment that had been chemically attacked by a corrosive agent.

This was a technical problem. Proving it to supervisory personnel and management was a sales problem. It required explanation and demonstrations in detail of the technical angle of corrosion procedures and demonstrations showing the difference between failure from wear and failure from corrosion. Quite often these two processes were so intermingled that, technically, no differentiation could be made and separation of one process from another could only be determined by a trial and error method of corrosion mitigation.

However, once management had realized that corrosion was costing considerable money and that in certain instances corrosion engineering could pay dividends, they became more and more lenient toward the expenditures for corrosion control. Field personnel became more cooperative, and, in fact, began to be the ones that found corrosion and called it to the engineers attention. They became so enthusiastic that the corrosion inhibitor began to appear as a "cure-all" to cure problems all the way from a broken crank shaft in the pumping unit to sanded up pumps.

**Problem in Reverse.** Here engineering ethics and management economy had to call a halt and put the brakes on the corrosion mitigation program.

To do this, certain criteria had to be established. This, of course, varied from field to field and selling this criteria of corrosion control became another job, a job that could only be accomplished through the presentation of data, analysis, calculations, and costs of "before and after" situations. Once again this was accomplished, and this time the example in hand was in the East Texas field. This field had been considered non-corrosive; yet with 300 pumping wells the company had eight pulling units operating full time. This meant that the wells were pulled somewhere on an average of 20 times per year. With the exception of subsurface sand troubles, crooked holes or paraffin, this number of pulling jobs seemed abnormal, especially in view of the number of tubing jobs that were performed.

So once again the machinery of corrosion calculations was set in motion. Data was gathered, inhibitors were tried, costs were presented and management was again convinced that corrosion control paid dividends. The above is a rather concise statement of the action taken in this case. Following is a brief summary of the detailed steps in this action. The preliminary program in this field was again of a restricted nature but after about one year's operation the facts were evident.

Here, however, management, in the form of field superintendents especially, were not satisfied with the type of corrosive measures that had been instituted in other places. They wanted some criteria to anticipate the ravages of corrosion so that it could be prevented. Here laboratory work came into place.

When correlated with corrosion

rates in the field which encompassed both material failure and coupon and water analysis evaluation, this work indicated there was a "critical oil-water ratio." This ratio was shown to be that above which corrosion of serious nature occurred and below which corrosion was practically insignificant. After presenting the data proving this point along with the economics of the situation, management agreed to treating all wells in this field which fell in one of the following categories:

- Oil-water ratio exceeded 80 percent water.
- Any well that had abnormal equipment failures. It was determined that without corrosion a number of pumping wells in East Texas required two pulling jobs per year. The policy was then established of reviewing carefully any well that incurred three or more service jobs in any 6-months period. Such a well was authorized for corrosion control treatment at the discretion of the field supervisor and field corrosion engineer.

**Figures Tell Story.** Perhaps the greatest tribute that corrosion control and the corrosion engineer in this company were ever paid was a simple, two-paragraph, letter from a field superintendent in East Texas. Concisely he told of how he had been able to reduce the number of pulling units in his area by 50 percent and decrease his over-all operating costs by the staggering figures of $60,000 to $100,000 per year through the use of corrosion inhibitors.

This particular man in management was definitely sold on corrosion control. It was quite gratifying to see members of higher echelons of management pencil notations on a copy of this letter such as "I, too, am impressed."

This type of work has demonstrated to the engineers and others in the technical end of corrosion work that there are very few basic essentials necessary to sell corrosion control to management. Essentially these basic ingredients are work, work, work and form of presentation.

**It Isn't Easy.** Do not be misled by the above into thinking selling corrosion control to management is easy; it is not. But it is possible, and it is probable. People in management did not

get there through closing their eyes to anything. When the figures, facts, and analyses are presented to them, they will be sold. To the writer the most basic fundamental of successful corrosion control can be summed up in one word—records. If adequate records are not kept, corrosion control can be meaningless and unimpressive.

If corrosion costs are abnormal, corrosion mitigation should, of course, be applied. If operations are going to proceed in an area where there is a good possibility and indications of corrosion, corrosion mitigation methods should be employed. The best example of the latter would seem to be in pipe line work. According to this company's pipe line experts, the cost of applying coating and wrapping and cathodic protection is so negligible compared to a minute number of failures as to almost make it foolish not to use these methods. Recently the writer was indoctrinated into some of these types of considerations when the production department of this company installed about 13 miles of high pressure steel water injection line. This line was in an area in Louisiana known to be swampy and marshy so naturally the line was coated and wrapped and the pipe line expert was asked to have one of his engineers run a survey to see if cathodic protection was needed.

This expert then informed the writer that the cost of such a survey would be considerably more than the installation of the cathodic protection and that the maintenance, power costs, etc. would be of such low magnitude as to be negligible. The question then arose as to how this would sound to management. However, by analyzing the cost of this line, the cost of survey (same as installing cathodic protection), the estimated cost of cathodic protection per year and the cost of a minute number of leaks, it was obvious that the expense of installing cathodic protection was warranted. The writer then became sold on this particular type of corrosion control.

Consider then the negative side of the question. Should corrosion mitigation processes or methods be installed on everything? It is felt that the answer is definitely no, even though the cost for corrosion mitigation for everything handled for this company would be insignificant as compared to other operating costs. To adopt an attitude of "treat everything" would be claiming that the technology of corrosion control had advanced to its peak.

This is definitely not true. Technical advantages have been found that decrease corrosion mitigation costs even further. To further explore such advantages, technical employees are needed. At the same time such technologists are exploring said advantages they can be paying their way by determining in which areas or in which instances corrosion mitigation is needed or warranted.

**Sale of Safety.** It should be stressed that selling corrosion control simply for the sake of corrosion control is useless except in the case of safety. In such cases as high-pressure gas lines, high-pressure vessels in plants, extremely corrosive acids, etc. another field of sale endeavor is found. This, of course, is the sale of safety. This must be geared to individual cases and the aid of the safety engineers in these particular cases will be invaluable. Of course, all of this must be encompassed in some sort of relative values.

For instance, determining corrosion costs on pumping wells is a rather simple and straightforward matter. Material is replaced; and labor costs money. These costs can be demonstrated and analyzed. Cost of replacing tubing in high-pressure gas wells and the cost of working over these wells can be closely estimated. Cost of repairing leaks in pipe lines, values of production lost and loss of revenue and downtime can also be demonstrated. The safety angle can also be presented as a sale point. But the main point is that corrosion control depends upon its survival for the most part in the field of economics. Economics are hard, cold facts. Calculated risks of losing reservoirs because of corroded-out wellheads can be established just as they are determined in design work in pressure rated wellheads, treating vessels, etc.

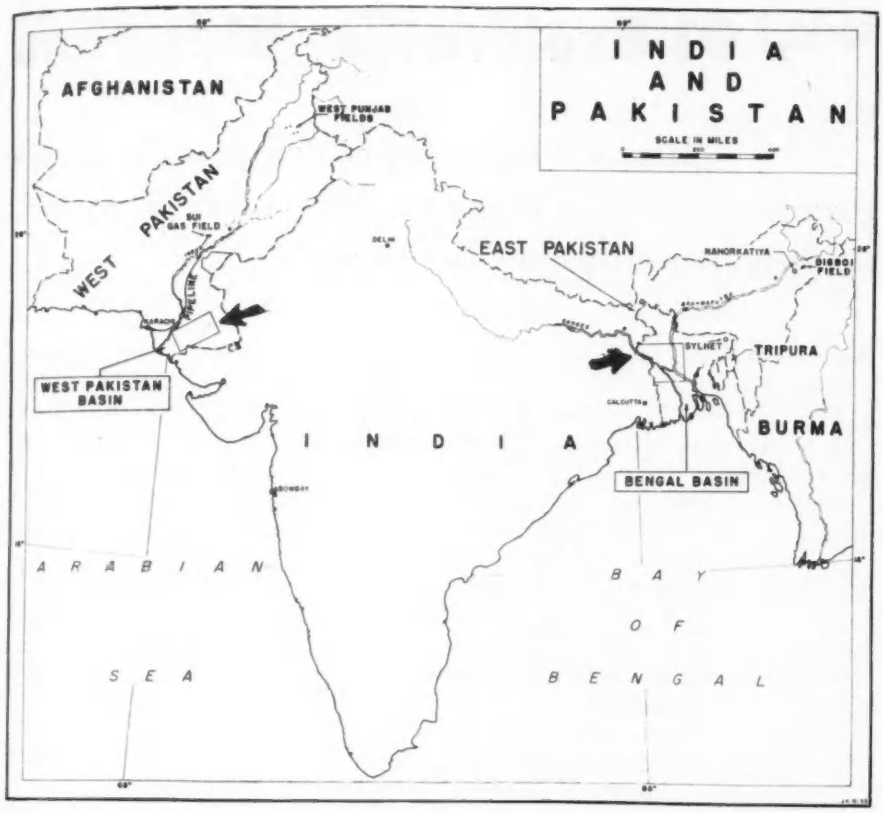
Presentation of the above goes toward making corrosion control data understandable, readable, and believable. The corrosion engineer has no better tool for accomplishing the above than his records. If a successful job of selling corrosion control to management is to be attained, records of individual operations, company-wide operations and industry-wide operations are essential. Technical data describing the effects of corrosion mitigation, of course are important to the corrosion engineer to perform his given duty, but for the purpose of selling management on the idea of corrosion control, such technical matter should be definitely subjugated to the field of economics.

**Dollars vs. Data.** The dollar sign has been said to be the master of the American people. This point will not be discussed but it can be stated that outside the field of personal safety, the dollar is at least one of the minor dieties of management. Perhaps the point of management being money mad has been overstressed, if so, apologies are in order by the writer, but as a corrosion engineer in the past, he had constantly been faced with the problem of showing payouts. This problem has been so stressed and injected into corrosion control work that it has now become one of the writer's own personal policies.

Therefore, in order to sell corrosion control to management, the economic point must be stressed. To do this one must be capable of demonstrating economic gains when corrosion control is undertaken. To demonstrate this *there must be records.* If adequate records are not being kept by a company it is suggested that everything within the power of the corrosion engineer be done to see that adequate records are kept. Granted that this might entail considerable work, but it is the belief based on the experience of the writer that such work will pay off. It has in this company and it has in others. The corrosion engineer must keep himself abreast of technology, must be capable of distinguishing between corrosion and other forms of equipment failure, and must be capable of making the proper application of basic corrosion control fundamentals. The above steps are necessary to accomplish corrosion control, but above all, records must be kept that demonstrate that corrosion control pays off. Do this and management can be sold. Do this and management won't have to be sold—they will beat a path to the corrosion engineer's door because he has a better *and cheaper* mouse trap.

**ACKNOWLEDGMENT**

Presented at University of Oklahoma, Corrosion Control Short Course, April 5-7, 1955.




# Stanvac Exploring 20,000 Square Miles in Pakistan

**By H. T. BRUNDAGE,** World Oil Staff

Standard-Vacuum Oil Company actively is exploring its two concessions which were granted by the Pakistan government late in 1954. Each concession covers 10,000 square miles. One is centered at the junction of the Ganges and Brahmaputra rivers in the far eastern part of the Indian subcontinent; the second is located near the mouth of the Indus river in the far west province of Sind.

Negotiations with a drilling contractor, Southeastern Drilling Company of Dallas, were under way late in 1955. It is likely that Stanvac will be drilling on the western concession by mid-1956.

Exploration in the western concession is proceeding somewhat faster than in the east. A seismic crew, equipped for both reflection and refraction shooting, is operating in West Pakistan. Progress in the west should be expected to be faster since the Indus valley is largely a desert area, and the Ganges valley is one of the most heavily-populated regions in the world.

By coincidence, the two areas are similar both politically and geologically. West of the Indus river, the highly-folded Tertiary and Mesozoic strata form the Kirthar Mountain range. The West Pakistan or Indus basin includes between 20,000 and 30,000 feet of sediments, mainly Tertiary, with perhaps some Mesozoics below, lapping eastward onto the central Indian shield, which carries all the way across the huge peninsula to the Bengal basin in eastern India and East Pakistan. There, Stanvac's Pakistan and Indian concessions, the latter comprising 10,000 square miles also, are contiguous.

Terms of the Indian and Pakistan concessions are similar. The Pakistan government will share in exploration costs through 25 percent participation, having agreed to invest funds on this basis to a maximum of $15 million. The government will share ownership of any crude found on the same basis, and Stanvac will buy the government's 25 percent share of crude at its wellhead value. Stanvac agreed to train Pakistan nationals for all phases of the work, and they are being employed to the fullest possible extent. There is a depletion allowance, and the company and the Pakistan government will share any resulting profits on a 50-50 basis.

Stanvac has marketed in this part of the world for more than 60 years.

Plans for additional prospecting by airborne magnetometer began in January, 1955, when the company signed an agreement with Huntings, Ltd., of London, England. The London firm agreed to survey a 120,000 square-mile area in the West Pakistan basin on a spacing ranging from 30 to 50 miles. This survey entailed 5000 flying miles. The operation was similar to a survey completed by Stanvac in 1951 in the Bengal basin, which, however, had a more concentrated grid pattern (one to three miles) and covered a smaller area (73,000 square miles).

In the Bengal basin, the previous magnetometer work is being followed up with a gravity survey. Two helicopters are being used in this operation. One of them was made available to the governor general of East Pakistan in September, 1955, so he could survey from the air the damage caused by a recent Ganges river flood.

Stanvac plans to move a seismic crew into the Bengal basin.

In West Pakistan, the aerial magnetometer survey by Huntings, Ltd., was completed in February, 1955, and two gravity parties since then have developed a number of leads that are being followed up by the seismograph party.

Stanvac surface geological parties have been at work in both basins during 1955.

The western concession is about 200 miles south of the Sui gas field. The Bengal basin concession is about 120 miles west of the recent drilling activity at Sylhet.

No doubt one of the reasons for Stanvac's vigorous activity in India, Pakistan and other areas outside of Indonesia lies in the unfavorable governmental climate that has developed in Indonesia since the end of World War II which has impeded the company's expansion efforts in its principal productive area. —**The End**

# 91 Exploration Bids Filed

**Here is a summary of new petroleum code governing operations in this Central American republic, formerly closed to private foreign capital.**

**By DON KLIEWER**
World Oil Staff

Before the end of the equality period provided in the new Guatemala Petroleum Code and Related Regulations, 29 groups had filed 91 applications for exploration rights in Guatemala (Table 1). The period for filing applications closed Nov. 23, 1955. Subsequent applications, however, will receive priority according to the filing date.

The new law supersedes a 1949 code which barred foreign oil interests from participating in oil exploration (World Oil, August 15, 1955, Page 192) and opens the way for private foreign capital (World Oil, July, 1955, Page 216). While no oil wells have been drilled in the central American republic, oil seepages and signs of natural gas have been reported in El Peten province. That area lies near the southern border of Mexico and southwest of new production discovered by Petroleos Mexicanos, the Mexican government oil monopoly.

About 22.5 million acres are potentially oil producing, according to Sam Malis, New York City economic consultant, who assisted in the drafting of the new oil legislation. Malis acted as a consultant to Salvador Mendoza, who, in turn, was consulted by President Carlos Castillo Armas in connection with the law.

It is through a change in official attitude toward foreign capital that Guatemala elected to change its restrictive oil code. The change resulted after the present Guatemalan government, headed by President Carlos Castillo Armas, rose to power in 1953 after overthrowing the Communist-

## Chart No. 1 — Guatemalan

**AREA—** Max 400,000 Hctrs.*
Min. 5,000 Hctrs.
**RIGHTS** Max 10
Concessions.

**TERM**
6 years Renewable
2 for 2 years each
Subject to 6 months advance notice.

**FILING FEES**
$500.00
per concession

**EXPLORATION RIGHTS GIVE THE AUTHORITY TO:**
Exclusive exploration of given area over a fixed period.
Construct buildings, campsites and all related auxiliary requirements. To search for, locate and stake out oil deposits. Employ all means of transportation, land, sea, air, etc.
Produce and use freely in its own work any oil discovered.

**DISCOVERY**
Discovery of one or more oil deposits in commercial quantities automatically converts exploration right into development right and is then subject to such development right regulations as in chart Number 2.

* Hectare equals 2.471 acres.

**EXCLUSIVE EXPLORATION RIGHTS**
1 to 10 Permissible

**CONVERSION**
Holder may convert to development right on all or part of exploration right, but must surrender to the government an area equal in size which holder retains. Holder has sole right to selection of area to be retained. Conversion from exploratory to development may be made prior to discovery of oil and holder is required to begin development within six months after conversion.

Charts
Prepared by:
SAM MALIS
OIL CONSULTANT
39 Broadway
New York City, U. S. A.

**OBLIGATIONS**
Start exploration work in 90 days. Spend on exploration work 30 c. per Hct. 3 years 1.05 per Hct. 4, 5, 6 years, 40 c. per Hct. thereafter. Payable yearly.
Within first 3 years stake out clearly defined point of reference as to boundaries of area. If oil is found in commercial quantities the oil deposit must be staked out and worked with due diligence. Holder is granted 5 years time from date of discovery to define productive area.

**LAND RENTALS**
PAYABLE EVERY 3 Mos.
1st. to 3rd year. 30c. per Hct.
4th to 6th year. 45c. per Hct.
7th to 10th year. 60c. per Hct.

**DEDUCTIONS**
Provided holder has expended the minimum exploration expenditures provided by the code, he will be given a credit equal to 75% of his yearly rentals.

**ABANDONMENT**
Holder must notify Dirección de Hidrocarburos 30 days in advance of election to abandon any part or all of area of petroleum right.

# Under New Guatemalan Law

supported regime of Jacobo Arbenz Guzman.

In establishing the republic's petroleum policy, Decree 345 says the policy "shall assure the fulfillment, in a prompt, uninterrupted and efficient manner, of the operations of discovery, development, exploitation, refining, transportation, and distribution of petroleum in Guatemala, preferably by means of private initiative and investment, in a manner which will be compatible with the national welfare."

**TABLE 1**

| COMPANY | Number of Exploration Rights Applied for |
|---|---|
| A. K. Swan | 10 |
| Garfield & Pasternak | 10 |
| California Exploration Company | 8 |
| Pequa S. A. | 6 |
| Archer Oil Company | 4 |
| Shawano Development Corporation | 4 |
| Seaboard Exploration | 4 |
| Malis Group, Halbert & Jennings | 4 |
| Story J. Sloane | 4 |
| Signal Oil Company | 4 |
| Union Oil Company | 4 |
| Standard Oil Company of Ohio | 3 |
| Esso Standard | 3 |
| Norman Texas Company | 3 |
| The Ohio Oil Company | 3 |
| Texas Petroleum Company | 2 |
| Sun Oil Company | 2 |
| Amerada Petroleum Company | 2 |
| Atlantic Refining Company | 1 |
| Tide Water Associated | 1 |
| Continental Petroleum Company | 1 |
| Atlas Petroleum | 1 |
| Bandini Petroleum | 1 |
| Central American Oil & Gas | 1 |
| Petroleum (Investment) Shell | 1 |
| Guatemala Iquam S. A. | 1 |
| Jaime Willard | 1 |
| Antonio Molino | 1 |
| Compagnia Petrolera Guatemalteca | 1 |

The new law's 214 articles include regulations:

- Permitting unitization.
- Requiring that stock companies organized in the republic with foreign capital must offer within 90 days a public option to Guatemalan nationals to participate in 30 percent of the initial capital as a minimum and on equal conditions with the founders.
- Requiring, at the President's discretion, that domestic petroleum demand be met before petroleum is exported.
- Requiring that competent Guatemalan nationals shall be given preference as employes in all branches of the oil companies, under equal conditions and pay as foreign employes. This preference must continue until 80 percent of the total employes is composed of Guatemalans.
- Requiring training programs, under certain conditions, for Guatemalans.
- Allowing removal of machinery and equipment, under specified conditions, unless the republic, through executive power, decides to buy the assets.
- Permitting importation free of "import taxes" of all required material and equipment which are not produced satisfactorily in the republic.
- Prohibiting export duties on crude and refined products.
- Allowing free conversion of funds to any foreign currency and transfer thereof to other countries.—**The End**

# Petroleum Code

## Chart No. 2

**AREA**—MAXIMUM 25,000 Hct.
Total 200,000 Hct.
**RIGHTS**—MAXIMUM 10.

**TERM**
40 years—renewable. Additional 20 years, upon request, will be granted provided holder has complied with all obligations under the law.

**FILING FEE $1000**

**DEVELOPMENT RIGHTS**
Include exploratory rights, plus right to install refining, processing, gas and oil. Transportation to any area in the republic.

**LAND TAXES**
Payable quarterly—each right as follows:

| | |
|---|---|
| 1 to 5 years | 1.50 per Hct. |
| 6 to 10 years | 3.00 per Hct. |
| 11 to 15 years | 6.00 per Hct. |
| 16 to termination | 4.50 per Hct. |

LAND TAXES ARE DEDUCTIBLE FROM ROYALTIES.

**EXCLUSIVE DEVELOPMENT RIGHTS**
limited to 10

DEVELOPMENT RIGHTS ARE DERIVED ONLY FROM EXPLORATION RIGHTS. THE STATE IS OBLIGED TO GRANT SAME.

**WARNINGS**
Holder of development rights that produce no oil in commercial quantities 3 years after discovery of pool will be given 90 days to start production or have right cancelled. If production took place during or after the first 3 years and then stopped, holder will be given 90 days to resume same starting from date 6 months after termination of the initial 3 years period or date of suspension.

**OBLIGATIONS**
ROYALTY—12½% of production excluding oil used in operations. May be taken in cash or in kind by government.
Within 3 years stake out limits of area.
Start drilling within 6 months after date of grant—unless oil has been discovered on exploitation right and duly staked out.
Define potential productive area.
Pay rentals and royalties.
Notify direcion of pool discovery within 15 days.
Produce as required by article 52 of code.* *
Provide storage for government oil not to exceed 30 days.

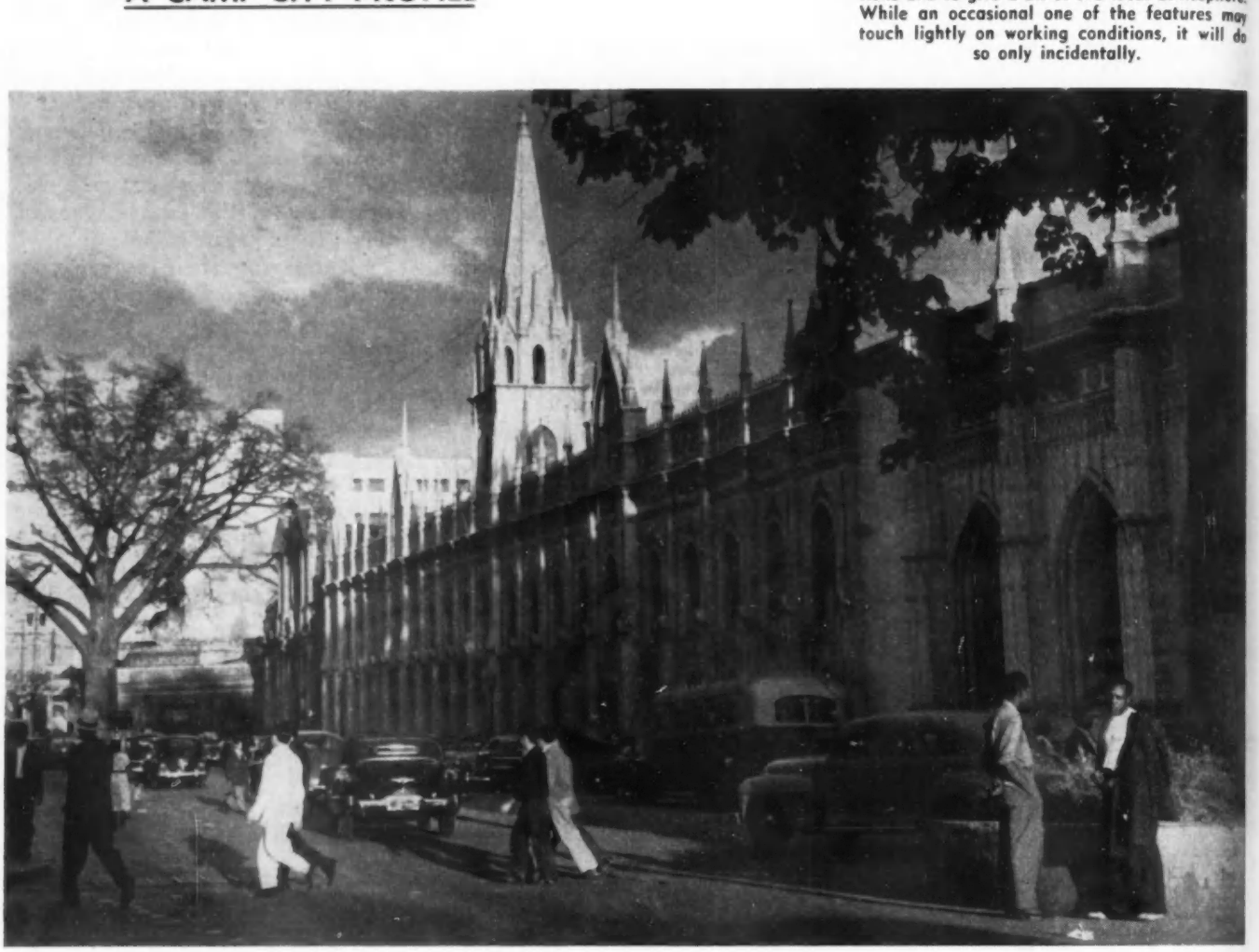
**JOINT OPERATIONS**
If an oil pool spreads over 2 or more separate rights the holders may unitize.

**OTHER PRODUCTS**
When in petroleum operation other non-petroleum substances are disclosed, acquisition will be governed by corresponding laws and royalties.

**Article 52: The holders of development rights may not be obligated to produce petroleum in quantities greater than the maximum efficient rate of production of the wells nor to increase their production in greater proportions than the requirements in equality of circumstances upon other producers.

A CAMP-CITY PROFILE

**This feature, one of a series describing important oil camps or cities throughout the world, is intended only to describe living conditions and to give a bit of the local atmosphere. While an occasional one of the features may touch lightly on working conditions, it will do so only incidentally.**



**In the heart of the 400-year-old city of Caracas is Universidad Central, one of the more outstanding remnants of Old Caracas, which is rapidly being replaced by modern architecture.**

# Caracas: a Storied Past, A Bright Future

**This bustling metropolis, steeped in the traditions of bygone days, looks to the future as the cultural and commercial center of Venezuela.**

**By RUTH H. GORMAN**

ON AND ON we drove. The few miles "up the hill" from Maiquetia, the site at sea level of the international airport for Caracas, to the nation's capital seemed endless. Awe-inspiring were the tree covered mountains, breathtaking the sheer drops at the edge of the road and hair-raising the 156 turns on the narrow, worn road which twisted up 3000 feet to the city.

Using the old approach, we were entering Caracas in 1953 for the first time—vowing never to leave if the trip "down the hill" had to be taken to do so. Only one month later, one of the engineering feats of our time was accomplished and the Autopista (superhighway) was opened. Built at a cost of $6 million a mile, tunneling through mountains and bridging val-

leys, the road up from airport and seaport is a four-lane express highway which can be comfortably covered in 15 minutes.

A grand approach to the capital of a unique country! A country which now presents an interesting economic phenomenon. Because of its wealth and geographic position, which facilitate development of many resources, its future progress is expected to overshadow the past and present.

Venezuela today has the most favorable exchange rate of any country in the world. This enables the country to allow free importation. The country is the largest buyer of U. S. goods in all of South America.

**Autopista del Este express throughway links center of Caracas with eastern suburbs, while bridge is part of the $6 million per mile superhighway between airport and seaport at sea level up 3000 feet to Caracas.**

Venezuela is open to immigration and welcomes large numbers of Europeans, who are chosen for their apparent ability to adapt well and easily to the country. The largest national group is Italians, the second Spaniards. The third largest colony is composed of North Americans, with 33,280 members. All told, there now are more than 350,000 foreigners residing in the country. Foreigners, as well as Venezuelans, enjoy civil rights.

Venezuela is on the northern coast of South America, about 11 degrees north of the equator. It was discovered by Christopher Columbus in 1498 on his third trip to America and was colonized and ruled from Spain for many years. Independence from Spain was declared in 1811. Caracas is the capital city and has a population of over 700,000. Spanish is the national language and much of the culture and many of the customs came from Spain. The bolivar, named after the Liberator, Simón Bolivar, is the currency unit of Venezuela. The rate of exchange is approximately Bs3.35 to a U. S. dollar.

Petroleum is the most important product exported. The country is the world's No. 2 petroleum producer and No. 1 petroleum exporter. Other big industries are being developed with an eye to changing from a one-industry country to a land of diversified income and prosperity. Future plans include a domestic steel plant to use some of the Orinoco's (river) rich iron supply now being mined by U. S. steel companies, a petrochemical industry, additional activity in diamond and gold mining, and further attempts to make the country self-sufficient in sugar, rice and corn.

Caracas is the governmental, commercial and cultural center of Venezuela. The main offices of most of the large domestic and foreign companies are located there. The annual average temperature due to the altitude is around 70 degrees. April to September are the warmest months with an average high temperature of 80-82 degrees, and in December, January and February the temperature falls below 50 degrees at night.

No company maintains camp facilities in or near Caracas as many do elsewhere in the country. It is necessary, therefore, to locate, rent, buy or build one's own housing. Although continual construction is going on throughout the city and housing has become increasingly easy to find, rentals are still high. Unfurnished apartments rent from $150 up. Unfurnished houses, more difficult to find, run higher. Waiting periods for dwellings must be expected and temporary housing can always be found by renting "vacation" abodes usually for one to three months. This consists of subleasing, completely furnished, a house or apartment while the occupant is on vacation.

Permanent houses and apartments in Caracas normally are rented without light fixtures, stoves, water heaters, cabinets and similar fixtures. Each individual must provide his own. Caracas power is 110-volt, 50 cycle current, so that all electrical equipment must be adapted, since stateside power is an AC frequency of 60 cycles.

For new residents, it is best to take to Caracas household furnishings although everything for the house can be purchased there at a higher price with a limited variety from which to choose. Types of furnishings chosen by U. S. Nationals in Caracas run from the most simple tropical rattan and bamboo to the practical modern or elegant traditional.

The English-speaking population in Caracas is scattered throughout the city, but largest concentrations of them are in the "East" in suburbs

On a mesa overlooking Caracas is Hotel Tamanaco, a 400-room luxury hotel with contour swimming pool, cabanas, snack and patio bars.

located conveniently near the schools taught in the English language and to the American and English churches.

There are no company maintained schools in Caracas, but excellent private schools are available. One of these, Campo Alegre, offers instruction in English for the nine primary grades in a modern, well-equipped building. The faculty of the school is made up of experienced U. S. graduate teachers, and a well-planned athletic program is part of the curriculum. A four-year high school is planned for the near future.

Bello Monte is a private school operated by the Presbyterian Foreign Mission, offering grade school instruction in Spanish and high school instruction in English. Numerous grade and nursery schools offer instruction in Spanish at monthly rates from Bs 30 to Bs 80 per month (about $9 to $25 monthly).

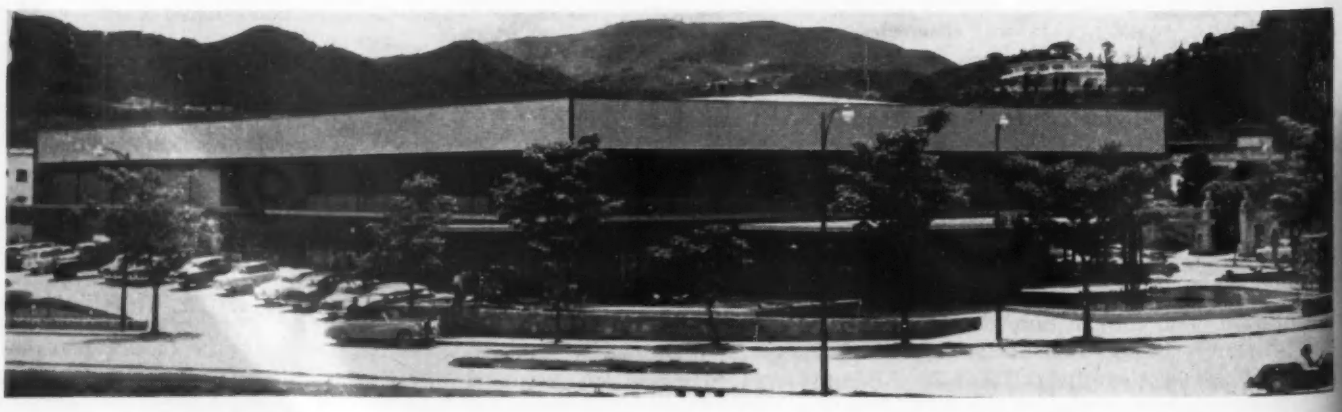
Four large universities are located in Venezuela, some state supported, others privately. Caracas' University City houses the faculties of the University's important schools, has an experimental hospital, some of the best equipped laboratories in the Americas and fine student dormitories. Buildings have been decorated by artists of the French school.

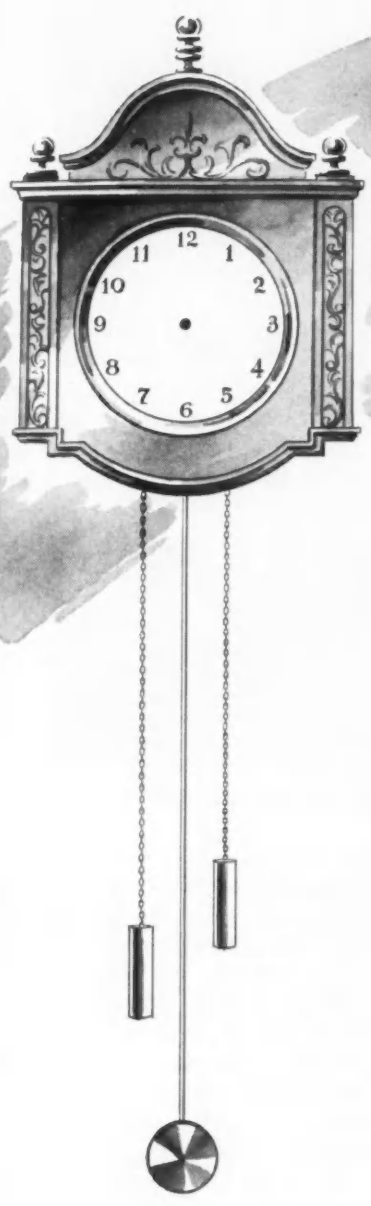
Servants of all nationalities are available, though wages are higher in Caracas than elsewhere in the country. Most North American families employ for general work, one maid who lives in and whose starting wage is about Bs 200 ($66) per month. A laundress is employed by the day at Bs 13 (about $4) per day and a noon meal. Cooks and nursemaids are also available, and trained nurses and practical nurses can be found when needed.

Religious activities can be continued in Caracas, for both denominational and non-denominational churches are available.

For oil company employes living in Caracas, companies have clinics staffed by Venezuelan doctors at which outpatient treatment and consultations are provided to employes, and at a small fee to members of employe's families. Services of specialists, surgery and hospitalization are for the personal account of the em-

Automercado is the new and ultra-modern shopping center located in the East.





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**Twenty-four hours a day—three hundred and sixty-five days in the year—the Driller or Producer can depend on getting "what he wants—when he wants it"—from the Wilson Supply Store that serves his rig or lease.**

**This was true 35 years ago—when there was but one Wilson Supply Store. It's true today at every one of the eighteen Wilson Supply Stores.**

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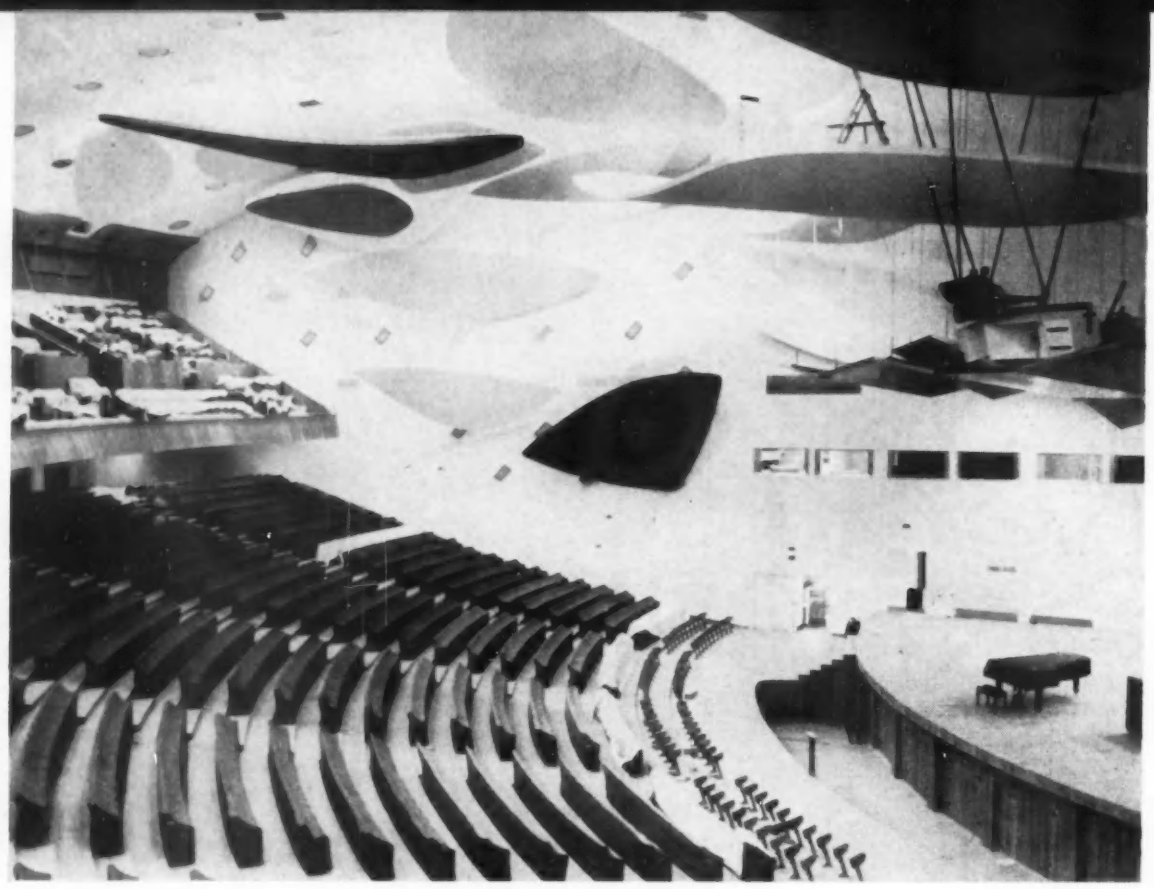


**Aula Magna (Great Hall) in University City, scene of the 10th Inter-American Conference in 1954, is the center of this extensive development.**

ployе. Numerous small clinics and a medical center are open to the public. Treatment and care are good. Specialists in all fields of medicine and dentistry are available.

There are private golf, riding, swimming, tennis and Little Theatre clubs in Caracas. Monthly dues are moderate. For entertainment there are many theaters showing first run pictures, generally U. S.-made, though European and Mexican movies, all of them with Spanish subtitles, can be seen. Nightclubs are spotted throughout the city offering varied entertainment and cuisines. All are expensive. There are many hotels and boarding houses, ranging from the new and luxurious Hotel Tamanaco to small "pensions."

For the North American in Caracas, there are the Centros Venezolano-Americano. During the day, the downtown Centro offers businessmen's lunches and in the evening. On weekends the popular Centro in the East offers delicious and inexpensive meals. Classes in English, Spanish and in the arts are offered at both.

The American Chamber of Commerce of Venezuela is designed to acquaint the U. S. people with Venezuela and to keep them informed of the importance of commerce between the two countries. All North Americans residing in Caracas automatically become members of the North American Association. In addition, an American Club occupies a former hotel in the city proper, and its facilities and membership are open to all.

*The Caracas Journal*, a twice-weekly newspaper printed in English is published in the city, and imported English language newspapers and magazines are always on sale.

Patrons of the arts can participate in a concert series or attend the Spanish ballet. Art exhibitions and expositions are presented frequently. There are Venezuelan Symphony and Philharmonic orchestras which, from time to time, invite internationally known guest conductors.

For the sportsman in Caracas there is horse racing every weekend at the city's Hipodrome, professional baseball (it's a baseball "crazy" country) at the University City stadium, wrestling at the National Stadim, polo, boxing, volleyball, golf, soccer, tennis, bowling, and swimming. The two olympic stadiums in Caracas each seat 40,000 persons. Boating, surf and deep sea fishing and swimming are available at nearby locales.

No company commissaries are maintained in Caracas as elsewhere in the country, and food prices are slightly higher here than in camp areas. There are open markets throughout the city in which one can purchase meats, poultry, fish, fruits and vegetables at slightly lower prices. A wide range of staples, frozen foods and canned goods as well as the other items listed above can be obtained at large, clean supermarkets run on the American plan.

Shopping in Caracas is easy. In the East where the English speaking population is concentrated, is a modern shopping center housing a supermarket, soda fountain, laundry, beauty and barber shops, bank, book store and specialty shops. English is spoken everywhere—even the police on duty in the area like to practice their limited vocabularies. In nearby Sabana Grande (street and section) are stores of every nature as well as bank and post office branches, making shopping trips into downtown Caracas completely unnecessary.

At either end of this street of stores are specialty shops such as one finds on Fifth Avenue in New York or Michigan Avenue in Chicago. Everything and anything can be purchased in Caracas—if not in one of the Sears Roebuck outlets throughout the city, then in a convenient neighborhood shopping area.

Wardrobes needed by Americans in

Caracas are similar to those needed in any cosmopolitan city, with an accent on elegance. Men wear suits during business hours, seldom wear hats, and need informal sports clothes for leisure hours. Evening clothes are not necessary, as a dark suit is usually acceptable anywhere, but they can be used.

Women wear casual clothes throughout the day, ranging from jeans and slacks (even for shopping) to simple cotton dresses. Wardrobes include several afternoon dresses, cocktail dresses and at least one evening gown. Hats, gloves and stockings are regular accessories. At least one wool suit and a coat are "musts", for the evenings are cold during the winter months and cool throughout the rest of the year.

Nothing is too dressy for Caracas; furs and jewels are conspicuous.

North American school children in Caracas wear what they would in the States. Blue jeans, sport shirts and gym shoes are almost a uniform, and have been adopted by the Venezuelan children as well.

It should be apparent from the preceding pages that the cost of living in Caracas is substantially higher than in the U. S. It is for this reason that a variable has been established for the Caracas employe to assist him to offset the difference in the cost of living.

If there is a fault in the North American existence in Caracas, it is that it is more difficult to get to know Venezuelans than anywhere else in the country. Conveniently, but unfortunately, the English speaking foreigner need never learn much Spanish. At least some English is spoken everywhere.

Caracas itself is a bustling metropolis, whose continuing growth and activity is thrilling to share and to see. Its beauty is breath-taking; its climate one of its chief attributes. New highways and airways are under construction, the population is spiraling. New industries are coming in and old one's are expanding.

Caracas is in the midst of a construction boom. Telephone and light systems are hard put to keep up with the growing demand for these utilities. It is a pleasant and friendly city in which to live; rich with its old traditions and customs, yet vibrant with its present ultra modern architecture and city planning. **—The End**

# What's Happening

## AMONG WORLD OIL MEN

Robert E. Mays

H. D. Schersten

W. S. Glendening

Creole Petroleum Corporation, which has created a new Budget department, bringing the total number of departments to 14, has reorganized the Economics department. ROBERT E. MAYS will head the new section, and H. DONALD SCHERSTEN will replace him as assistant manager of the Comptrollers department. JACK F. HOLMES will replace Schersten as procedures, statistics, and auditing coordinator. WILLIAM S. GLENDENING, head of the Caracas Petroleum engineering section, becomes assistant manager of the Western division in Maracaibo.

•

W. E. V. ABRAHAM has retired as managing director of the Burmah Oil Company, Ltd., retaining his position as a director of the company. His successor is W. E. EADIE, who has been assistant managing director since 1951 and who has served the company 34 years. Abraham also resigned from the board of The British Petroleum Company Ltd., and Eadie has been appointed to fill the vacancy.

•

HARRY D. GASARCH has been appointed assistant comptroller of Socony Mobil Oil Company Inc., after having been with the company since 1929 and manager of Socony's comptroller's foreign department since 1953. He often was on assignment in Western Europe, West Africa, and the Middle East while in the foreign department.

HENRY E. McAULIFFE has been named vice president and general manager of Mobil Oil Company de Colombia. He will succeed A. D. GRAVES, who is returning to the company's New York office to serve as an assistant to the producing committee member responsible for Eastern Hemisphere operations.

McAuliffe joined Socony Mobil as a petroleum engineer in 1945. Since 1950 he has been in charge of special studies in the Producing department. He is a past chairman of the New York Petroleum Section of the American Institute of Mining and Metallurgical Engineers.

•

R. B. HURLBUTT has been elected president and a director of Siboney Development and Exploration Company. Former vice president of Siboney and present chief geologist of Crescent Corporation, Hurlbutt has spent considerable time in Cuba supervising Siboney's operations.

W. F. STYLER, JR., was elected vice president of Siboney, in addition to his present office of treasurer, and NYE McLAURY was elected assistant secretary. Both Styler and McLaury occupy similar positions with Crescent.

•

G. W. E. PADDOCK, petroleum engineer with Khanaqin Oil Company, a subsidiary of The British Petroleum Company which operates the Naft Khaneh oil field in Iraq, will return to London in January. Paddock, who ultimately will return to Iraq, arrived in the U. S. for a visit on October 10 after a three-week tour of Canada.

G. W. E. Paddock

•

W. D. MURRAY, who recently resigned from his position as London manager of M. and C. Switchgear Ltd., will continue in a consulting capacity. J. HODGE, who has been with the company 16 years, replaces Murray.

# THE ONLY TRUCK POWERED SERVICING UNIT WITH

# COOPER TR UNIT

## FEATURES

Constant mesh helical gear power transfer and hypoid gear 90° drive are completely sealed in oil, run quietly and require no adjustment. ● Only short, low speed chain drives from countershaft to drums are used. ● Better spooling, easier on lines, fewer wearing parts — lines go directly over mast crown without the use of reeving sheaves. ● Legal in weight — Drums are located for proper loading of axles — no excessive loading on truck frames behind cab — no excessive overhang on rear of unit. ● Smooth, uncluttered housing is easy to keep clean. ● Ample bed space (63″) between cab and drums for 5 man cab or other equipment. 43″ from drums to end of bed. ● Air friction drum clutches are self adjusting. ● All controls, including transmission shift, at operator's position. ● Mast equipment — Single pole or double pole pipe masts, and fabricated guyless derricks. ● Built in three sizes: Model TR32 rated 4,500; Model TR36 rated 6,000; Model TR42 rated to 10,000.

UNIT SHOWN IN PHOTOGRAPH —
MODEL TR-42-36

**TRUCK** — International RF-192 — Motor RD450 (RD501 available).

**WINCH:** Double drum. Sandline drum brakes 36″ dia. x 6″ face.

Tubing drum brake 42″ dia. x 8″ face.

**Brake bands dead end, equalized and lined with 1″ thick blocks.**

Air friction clutches.

5 speeds on sandline drum.

10 speeds on tubing drum.

Maximum single line pull on tubing drum 46,000 lbs. without slipping clutch.

**LINE CAPACITY:** Sandline drum 11,500 ft. of 9/16″ (can be furnished with 42″ dia. x 8″ brakes on sandline drum with capacity of 14,900 ft. of 9/16″).

**MAST:** 65 ft. single pole, 13⅜″ x 10¾″ pipe with three crown sheaves and sandline reeving sheave above crown. Single line raising and telescoping, auxiliary winch at extreme rear for operating mast.

**WEIGHT:** As shown, total 34,360 lbs. Front axle — 9,160 lbs. Rear axle — 25,200 lbs.

**HEIGHT:** Overall 10 ft. 8″.

**WIDTH:** 8 ft. 0″.

**LENGTH:** 40 ft. 4″.

# MODERN ALL GEAR & TORQUE TUBE PRIMARY DRIVE

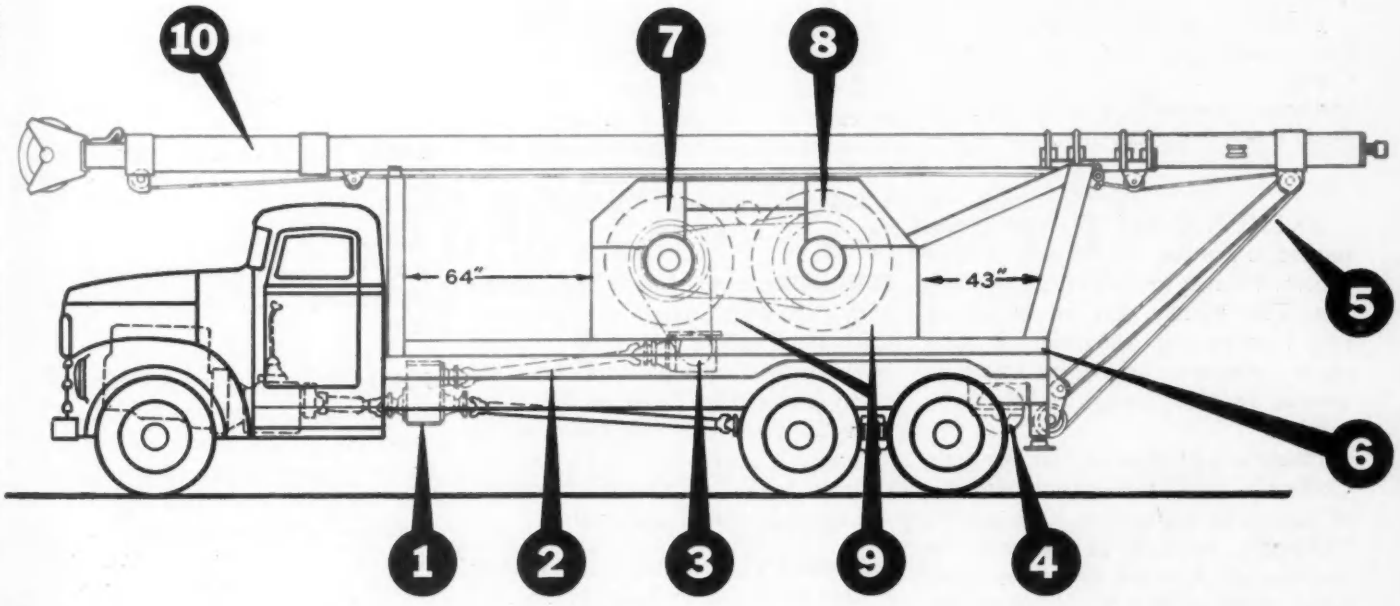
The COOPER TR Servicing Units have been designed to overcome the usual objections to large truck units.

Note on the diagram below that the power is transmitted through gears, torque tube and *short* slow speed heavy chains, actually eliminating chain and sprocket wear, noise and troublesome adjustments.

The load is balanced over the weight bearing axles, permitting higher road speeds and more maneuverability in the field.

Note, that lines go directly from drum to crown of mast leaving rear of bed free of dangerous running sheaves and that ample free bed space is provided in between cab and drum housing. The unit can carry a full crew and tools to the job.

The operator's view of the well head is clear. All clutches are finger tip, air valve controlled. All transmission speeds are conveniently obtainable at operator's position.




1. Constant mesh helical gear power transfer — sealed in oil.
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6. Control position optional for operator, on folding platform or on ground.
7. Five speed sandline drum — Air clutch, self-adjusting.
8. Ten speed tubing drum — Hi-Lo air clutches, self-adjusting.
9. Mechanically equalized Brake Bands lined with API Blocks. One point adjustment.
10. Telescoping single or double pole masts and fabricated guyless derricks.

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**The most complete line of well servicing equipment. There is a proper size and type to fit any depth well or any field condition. You can service them faster, safer and at less cost with a COOPER.**

**FRED E. Cooper, Inc.**

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# a WORLD of OIL

By **DON KLIEWER,** World Oil Staff

W. W. Stevenson

James I. Morris

W. W. STEVENSON, formerly district drilling engineer for Mene Grande Oil Company in the San Tome district of Venezuela, has been named drilling engineer for the Venezuelan operation of Perforaciones Guarico C. A. and Perforaciones Delta C. A., Venezuelan subsidiaries of Delta Drilling Company.

JAMES I. MORRIS, formerly office manager for Loffland Brothers Company of Venezuela at Maracaibo, has been appointed office manager of Delta's two Venezuelan subsidiaries.

•

ARTHUR H. ELLIOTT has been named executive vice president and general manager of Iricon Agency Ltd. The agency acts on behalf of nine independent American oil companies owning an aggregate 5 percent interest in the Iranium Oil consortium.

Elliott was graduated from Amherst College in 1915 and began a long tour of service with Standard Vacuum Oil Company, working in Malaya, Indonesia, and London, as well as in the home office in New York. He will be a director of Iranian Oil Participants Ltd., and of Iranian Oil Services Ltd., and will be in charge of Iricon Agency Ltd's. London office.

•

MITCHELL STARK, formerly on the staff of the Producing Coordination department of Standard Oil Company (New Jersey) in New York, now is producing superintendent for International Petroleum Company, Limited, at Talara, Peru.

Stark received his B.S. degree in petroleum engineering in 1938 from the University of Texas, at which time he joined Humble Oil & Refining Company. Except for three years of military service—from 1942 to 1945—he was with Humble until 1951. At that time he joined Jersey Standard.

**AUSTRIA:** In August, the nation's 787 producing oil wells yielded a total of 2,172,580 barrels of oil . . . High paraffin content crude has been found in Austrial Petroleum Administration's Kagran 5 at Vienna after a temporary blowout.

**BRAZIL:** Latest report—for October, 1955—shows five wells spudded in during the month, three completions, eight drilling with footage totaling 16,348. Production amounted to 198,-640 barrels.

**CUBA:** Siboney Development and Exploration Company expects to begin drilling its first well shortly. Through agreement with Caribbean Petroleum Associates, Inc., Siboney owns a half interest in about 5 million acres on which exploratory operations are being conducted.

**ECUADOR:** Protests have been lodged with Peru and Canada over the concession to explore for oil in any area between the Cenepa and Santiago rivers granted by Peru to the Peruvian Oil and Minerals Company of Canada. The reason: the area is also claimed by Ecuador, which considers the concession null and void.

**GERMANY:** Gendorf 1, a wildcat drilled by Deutsche Vacuum Oel AG. for the joint interest Bayerische Mineral-Industrie AG.-Gewerkschaft Elwerath-Preussag in the Bavarian Molasse basin near the Austrian border, tested at a rate of 678,020 cubic feet of natural gas a day . . . A second oil horizon has proved productive in Wintershall-Deutsche Vacuum-Itag's successful oil well at Landau . . . At year's end, estimated crude production for 1955 was put at 22 million barrels, 3 million barrels greater than during the previous year.

**GREECE:** After intensive geological, gravimetric and reflexion seismic preliminary surveys, Ilios and C. Dellmann Bergbau GmbH. have reached 3900 feet in the wildcat Ardanion 1 on a joint concession in East Thrace.

**GUATEMALA:** The Standard Oil Company (Ohio) has formed a subsidiary, Sohio Caribbean Company, to conduct oil exploration operations. Application for an exploratory concession was scheduled to be submitted immediately.

**INDIA:** A geological survey team from Andhra University, exploring for natural gas in behalf of the government, is conducting operations in the Amalapuram area of East Godavari.

**INDONESIA:** Conciliation talks were under way in the SVPM Oil Company strike near Palembang, Sumatra, which reportedly is resulting in a loss of approximately 45,000 barrels of oil daily.

**ITALY:** For financial reasons, Ente Nazionale Idrocarburi was reported negotiating with Cities Service Company and Phillips Petroleum Company on subcontracting oil and gas exploration operations in the Po valley.

**JORDAN:** Parliament has granted an exploration concession to U. S. independent oil producer Edwin W. Pauley whereby the Pauley interests will be permitted to explore all of Jordan for eight months, then to select a maximum of one-third of the kingdom for drilling, if tests are favorable. The pact calls for a 50-50 division of profits after Pauley regains exploration costs.

**LIBYA:** The Ohio Oil Company was negotiating for oil concessions and announced it expects to acquire considerable acreage under concession terms. Ohio also is continuing, with associates, extended exploratory programs in Egypt, British Somaliland and Somalia . . . Texas Gulf Producing Company has been granted a concession to explore for oil on 5 million acres through its subsidiary, Libyan American Oil Company.

**MEXICO:** August crude production was 7,743,000 barrels, while average monthly production during the first eight months of 1955 equaled 7,665,-000 barrels, as compared to 6,971,000 barrels the previous year.

# ENGINEERS FROM 124 WATER FLOODS

# REPORT ARMOUR CATIONICS

# BANISH METAL CORROSION...

# STOP BACTERIA PLUG-UPS!

**In actual field tests, concentrations as low as 6 ppm. reduce corrosion 99.5% and give complete bacteria control. Cost? As low as 0.7 mill per barrel of water!**

**Engineers installed steel test plates** in untreated wells and in wells of the same flood system treated with Armour cationics. Less than one month later the plates were weighed. Comparisons *proved* that as little as 6 ppm. of an Armour cationic reduces corrosion up to 99.5%. Field observers also report that turbid flood waters are now cleared and water meter troubles eliminated in fresh, brine and produced waters—*positive proof* that algae and sulphate-reducing bacteria are *completely* controlled! Costs run from 0.7 to 2.1 mills per barrel of water, and no expensive injection equipment is needed.

**Armour cationics** such as the Arquads®, Armac® C, and Duomeen® C are solving corrosion, algae and bacteria problems throughout the petroleum industry. They give maximum protection at low, economical concentrations. Armour cationics *plate* the inner surface of pipes, forming a tough, corrosion-preventing film that resists washing away and won't evaporate. And this same film completely smothers algae and bacteria—resistant strains have no opportunity to develop!

**Find out how Armour cationics** can banish corrosion and stop bacteria plug-up for you. Send the coupon now for our latest product information booklets and for our new Corrosion Inhibitor Questionnaire.

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Please send me:

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W1

ARMOUR CHEMICAL DIVISION

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**NEW ZEALAND:** The government is selling its share of The British Petroleum Company of New Zealand to The British Petroleum Company Limited in order to withdraw altogether from BP of New Zealand.

**SAUDI ARABIA:** Crude output in October amounted to 31,075,696 barrels, or 1,002,442 barrels daily.

**SICILY:** ARPE (Augusta Ricerche Petrolifere, S.p.A.) a joint affiliate of Standard Oil Company (New Jersey) and RASIOM (Raffineria Siciliana Olii Minerali) were drilling at 6300 feet in November on Melilli 1 test, eight miles southwest of Augusta, with projected depth of about 7000 feet . . . On the west flank of Mt. Etna, the Bronte well, being drilled by the same companies, reportedly was fishing for drill pipe at 4434 feet, with a gas show at 3900 feet.

**SPAIN:** Campsa, oil distribution monopoly; Banco Exterior de Espana; and Banco Iberico reportedly are forming a company called Iberica de Petroleos to engage in oil operations in Venezuela.

**VENEZUELA:** For the first half of 1955, crude production totaled 381,965,000 barrels; crude exports amounted to 289,837,000 barrels; and products exports reached 69,411,000 barrels.

## Lower California Oil Area Found, Says Pemex

A sedimentary marine basin with proven hydrocarbon resources has been discovered in Lower California, according to Petroleos Mexicanos, government oil company.

Six wells have been drilled in the desert area of Iray Purisima, north of La Paz, but details of results have been withheld.

Previous exploration of the area dates back to 1925, when the Maland Oil Company drilled wells unsuccessfully in Baja California. The project that company abandoned was brought to fruition this year through application of modern techniques of exploration, Pemex officials said.

## Photos from Behind the Iron Curtain

Above is the Soviet-manufactured mobile Uralez BU-2-20 core drilling rig in operation in Czechoslovakia.

This Soviet drilling rig BU-40 (right) is being used for drilling to depths of 4000 feet. A 14-man crew reportedly has drilled 600 feet in 24 hours, or 600 percent more than the daily norm. From October 20 to October 25, this crew is reported to have drilled 1575 feet.

## Socony Reorganization Continues Decentralization

Effective January 1, 1956, foreign operations of Socony Mobil Oil Company of New York City became the responsibility of Mobil Overseas Oil Company, a wholly-owned affiliate, with offices at 26 Broadway, New York City, as before. This represents a reorganization of Socony's foreign operations, and continues a trend toward decentralization.

Mobil Overseas Company will operate with a high degree of autonomy, and will have assets of over $500 million. Together with its affiliates, the new company will have about 25,000 employes, more than 300,000 barrels of daily crude production, refinery capacity of 220,000 barrels daily, a fleet of tankers, and marketing operations in Europe, North and West Africa, Latin America, and the Middle East. It will integrate and be responsible for all activities of Socony Mobil and affiliates in Latin America and in the Eastern Hemisphere, except for Socony's interest in Standard-Vacuum, interests within major Middle East concessionary areas, and producing operations within Peru, Columbia, and Venezuela.

Officers and directors of the Mobil Overseas Oil Company, all chosen from senior members of the Socony Mobil group, are: President P. V. Keyser, Jr., who continues also as a director and vice president of Socony Mobil; F. S. Cooper, Jr., director and vice president in charge of marketing; W. G. Corwin, director in charge of producing; A. V. Danner, director and vice president, crude and wholesale marketing; A. C. Ingraham, director and vice president, supply and distribution; R. R. Jackson, director in charge of manufacturing; W. L. King, director and general counsel; F. E. Powell, Jr., director and vice president, marine trade; J. H. B. Wellacott, director of finance; A. L. Lanckton, secretary; E. J. Glocke, comptroller; F. L. White, treasurer.

Effective at the same time, Socony Mobil Oil Company will form its Department of Middle East Affairs. Robert Siegel will direct this new department of the parent company.

## Oil Activity Heightening As Israel Plans Reported

Lapidot's oil discovery at Heletz was at total depth of 4965 feet in November, waiting on special equipment for completion. Seven-inch casing had been run to 4931 feet, through the upper pay, seven feet thick, which occurred at 4906 feet.

About 16 feet of oil-saturated Nubian sand was found below the casing seat and completion was expected in the lower pay, probably through 5½-inch slotted liner. The lower pay has tested 96 barrels of 32-gravity oil in 42 minutes with ¼-inch chokes and bottom-hole pressure of about 1850 pounds. On a 3/16-inch choke the same pay tested 500 barrels daily. The upper pay, now cased off, tested 47 barrels in one hour, or at the rate of 1128 barrels daily, with bottom hole pressure about 1500 psi.

A 7-inch pipe line was being constructed from the well to the railhead at Ashkelon, a distance of five miles, to move the oil to the refinery at Haifa. Drilling equipment has been moved to two offset locations, one about 1300 feet northwest, the other about the same distance southeast of the discovery.

Near the discovery area, Pan-Israel Oil Company and Israel-Mediterranean Petroleum Inc. own 250,000 acres along the southeast flank of the gravity axis of the discovery and were core drilling. They expected to start a deep test with a new rig that was being loaded at the port of Houston, at a location seven miles southeast of Huleiqat. The same company was fishing for drill collars below 8450 feet at the Kurnub structure in the Negev (see photos), and may drill to basement which may occur anywhere between 9000 and 14,000 feet, depending on thickness of Paleozoic beds.

The rig will be moved to a prospect in the immediate vicinity of Haifa after completion of the hole at Kurnub, according to current plans. In addition, the same company plans to drill a 3500-foot wildcat test in the Dead Sea area with a cable tool rig.

Israel Continental Oil Company was rigging up to drill a deep test five miles east of the Huleiqat discovery well. Israel American Oil Company expected to drill another wildcat, located 22 miles due south of the same well.

Jacob Nowak, director of Lapidot Israel Petroleum Company of Tel Aviv, and of Water Works Ltd. of the same city, visited the U. S. in November, and later announced the placement of orders for $2.5 million worth of drilling equipment by Israel Purchasing Service, Inc. of New York, commercial arm of Ampal-American Israel Corporation. Four rigs have been purchased, two each for Israel Water Works Ltd. and for Matzada, a drilling company set up jointly by Lapidot and Israel Oil Prospectors Ltd.

The rigs are medium-heavy and of two types. One of each type goes to each company. One type is a torque-converter rig with 133-foot mast for 7000-foot depths. The other type is a rig with 143-foot mast for 9000-foot depths. Both are air-controlled and will use 4½-inch drill pipe. Delivery of the four rigs will bring the total operating in Israel to nine. All are of U. S. manufacture. Lapidot has three, Tri-Continent Drilling Company, contractor for Pan Israel, has one and Pontiac Drilling Company has one, which currently is working for Israel Continental.

In Moscow, the Israeli Embassy announced the signing of a contract whereby Israel will purchase about 375,000 tons of Soviet crude and fuel oil, in exchange for 15,000 tons of bananas, oranges and lemons from Israel.

**These are the surface beds in the vicinity of the Kurnub structure, where Pan Israel Oil Company Inc. and Israel-Mediterranean Petroleum Inc., the Buckley group, are drilling and show the Judean limestone and other Cretaceous strata.**

Trudy Ben-Dor photo.

**This is the site of the Kurnub wildcat.**

## Italian Monopoly Agencies Extending Interests Abroad

While foreign oil interests are expanding their operations in Sicily, the Italian State Hydrocarbons Monopoly is turning its attention to expansion abroad. Negotiations were continuing between Ente Nazionale Idrocarburi, the Italian monopoly, and Libya for the creation of an Italo-Libyan State Oil Monopoly which would undertake petroleum exploration in Libya.

AGIP-Mineraria, a branch of ENI, recently acquired a share in International Egyptian Oil Company, it was reported. Research work has been under way in the Suez Canal zone, and two structures have been discovered in the Wadi Feiran and Belayim zones, where four wells were in production.

Also, an Italian trade mission was to have discussed in Yemen an Italo-Yemenite oil cooperation agreement. The agreement, if approved, would lead to the creation of an Italo-Yemenite State Oil Monopoly to conduct petroleum exploration and development in Yemen with monopoly rights.

# DRILLING HINTS

These **How-To-Do-It** Ideas Can Save You Money

## Container Quick Drys Rotary Cuttings on Rig

A container to quick dry rotary cuttings around a steam rig can be made from sheet metal and welding rod. It can be built to any convenient size, just so the bottom and sides fit an available steam line. Bottom of the container is shaped to fit the line to increase heating area. Handles to aid in carrying the drying can are made from welding rod. The container may be divided into multiple compartments so that different batches of cuttings can be dried simultaneously.

**How-To-Do-It Ideas**
Earn Money, too!

**$10**—WORLD OIL editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of that latest idea and send it in with a picture or drawing of the installation . . . if accepted, $10 will be yours. Send those money-making ideas today to Hints Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

## Portable Wire Line Unit Speeds Well Measurements

If several portable work-over units are in an area, a rig-mounted measuring unit is unnecessary on every rig. By making a separate portable, self-contained unit, several rigs may be serviced by the same one. Skid-mounted, the unit can be used from the back of a pick-up truck or it may be set on a stand as shown.

The stand is made from 2-inch pipe with plates on the foot to provide level footing in soft ground. Four ears stick up, two on each side, to fasten the unit securely. Sides are made up from channel iron with the measuring reel mounted on the front. The belt is driven with a small gas engine. The engine is mounted on separate skids with set screws to provide adjustment of the V-belts.

The entire unit has a bale on the top so it may be set onto a truck and quickly moved to another rig.

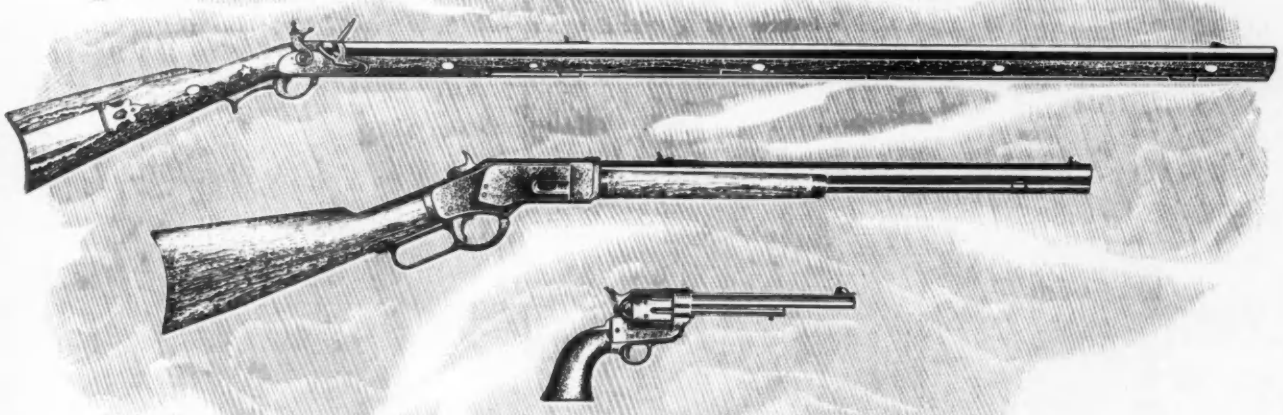
## Pipe Slide Extensions Form Stairway Supports

To insure a sturdy companion stairway to the pipe slide, one rig has outrigger braces that slide out from under the pipe slide to form strong dependable supports for the stairway. Metal plates are welded at the center brace and the outer brace of the pipe slide. An "L" shaped slot is cut in these braces to conform to the shape of the angle iron used for the stairway supports. The length of the angle iron is the same as the width of the pipe slide.

When the angle iron is placed in the two metal brackets that are welded to the under side of the slide, they can be collapsed to fit under the slide or, extended to form the supports for the stairway as noted in the photo.

These braces prevent the stairway from wobbling or sagging and make temporary bracing unnecessary. When tearing down, the stairway is removed, the supports are pushed in under the pipe slide and the slide is removed and handled separately.

# PIONEERS



*The "Kentucky rifle" – longer, lighter, more accurate than the preceding musket – opened the land beyond the Appalachians, in the hands of scouts, woodsmen and mountain men. The Winchester 73 repeating rifle gained immortality as "the gun that won the west." And the Colt "Frontier," also known as the "Peacemaker," the favorite sidearm of outlaw and lawman alike, has been called "the gun that tamed the west."*

Though the pieces above are now past history, pioneer days have never ended. We have felt them always with us, here at *H. C. Smith Oil Tool Co.* And our work bears witness to it. Within our 20 years of company life we have helped to pioneer in the development of jet action bits...the first long-tooth bit was ours...the first hole-opener with the reamers above the bit...the first cross-section bit with forged cutter brace and one-piece pin for the strongest construction known.

While we take a natural pride in these developments, we mention them here simply as examples of the design, engineering and construction that have led many operators to agree that "For fast, straight, full-gage hole, You can't beat *H. C. Smith Bits!*"

OUR 20th YEAR
H C Smith
OIL TOOL CO.

**H. C. SMITH OIL TOOL CO.** *-every bit as good as the best*

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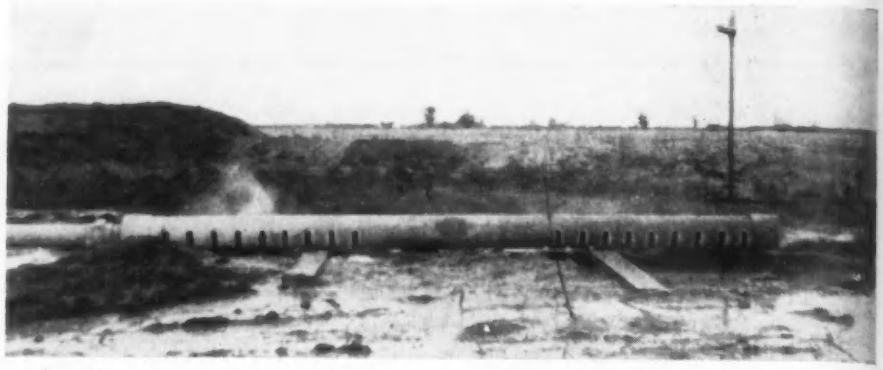
BRANCHES IN ALL PRINCIPAL OIL CENTERS IN THE UNITED STATES AND CANADA

DRILLING HINTS . . .

## Install Blowdown Muffler To Protect Vegetation



Boiler chemicals in steam are destructive to the growth of vegetation. For this reason, unless steam blowdown is contained in someway, several acres of vegetation may be killed.

One contractor has constructed a muffler from a length of cast-off casing to aid in containing steam blowdown. The muffling action is obtained by capping one end of the casing and cutting circumferential slots in the casing. The open end of the casing is placed over the end of the steam blow-down line and the slots in the muffler are directed downward. Steam is ejected against the ground and not allowed to blow over the surrounding acreage.


KEEP YOUR MUD IN BALANCE

with

"Mud-O-Graf"

- Provides accurate information for uniform mud control.
- Helps prevent blowouts by showing the duration and relative amount of gas in gassy streaks.
- Eliminates guesswork in the use of weighting materials, chemicals, and water.
- Indicates graphically all heavy and light streaks in the circulating system.

The condition of mud in the hole is recorded automatically during every minute of the drilling operations. Weight variations of less than 1/10-pound per gallon can be detected. Mud-O-Graf has been proved in fourteen years tough field service. It eliminates trial and error methods of adding weighting materials. It detects gas or salt water incursions which could cause blowouts.

WARREN AUTOMATIC TOOL CO.

Manufacturers of Pit-O-Graf and Rig Runner.

Houston CApitol 4-2511 | Odessa 6-5861 | Lake Charles HEmlock 6-2265 | New Iberia 2-7131 | Harvey FIlimore 1-3721

Hobbs, N. M. 3-8218 | Lafayette 5-5313

Export Representative: International Oil Equipment Co.
30 Rockefeller Plaza, New York City

## Strap Spare Drilling Line To Rig When Skidding

When rigs are skidded from one location to another without unstringing the derrick, the spool with the new drilling line may be raised and carried on the corner of the rig. This allows it to be moved right with the rig and set down on the new location. The wire rope remains in position to be spooled off a few feet at a time when cutting-off the dead line.

Previously the spool was raised and set on the derrick floor. Here it is picked up only a foot or so and tied to the end of the beam on the rig floor with a chain. As soon as the rig is spotted, the chain is unhooked and the spool set down in front of the dead line anchor where it stays for the remainder of the drilling operations.

# AVAILABLE JOHNSTON by AL CAPP

HALP!! -I HEARD YO' JOHNSTONS GOT A BOB-TAIL PANTHER!!
HEVVINS, NO!! — IT'S MERELY A BOB-TAIL PACKER!! — A TESTIN' TOOL THAT PREVENTS EX-TROOSION!! -
IT'S A PIECE OF E-KWIP-MUNT, THAT MAKES TH' PACK-OFF UP TO 30% MORE EFFECTIVE!!
OH!!
DON'T GO!! SET A SPELL, AN' TELL ME ALL 'BOUT IT!!
SORRY!! US JOHNSTONS GOTTA GET T' TESTIN'!!
-AN' WITH TH' BOB-TAIL PACKER, WE CAN DO A BETTER JOB THAN EVER BEFORE!!
Al Capp

C-5410

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# JOHNSTON TESTERS

**first in drill stem testing**

HOUSTON, TEXAS

LOS ANGELES, CALIF. • CALGARY, CAN.

FORMATION AND CASING TESTING — JOHNSTON

## Extra Block Aids Suction Line Adjustment

When mud pumps are trailer-mounted, a simple rig may be used to adjust the height of the suction line. One set of wire ropes support the A frame which holds up the suction line. Another set is strung through a sheave on the end of the A frame, down to a block on the suction line and then back up to a dead end at the apex of the A frame.

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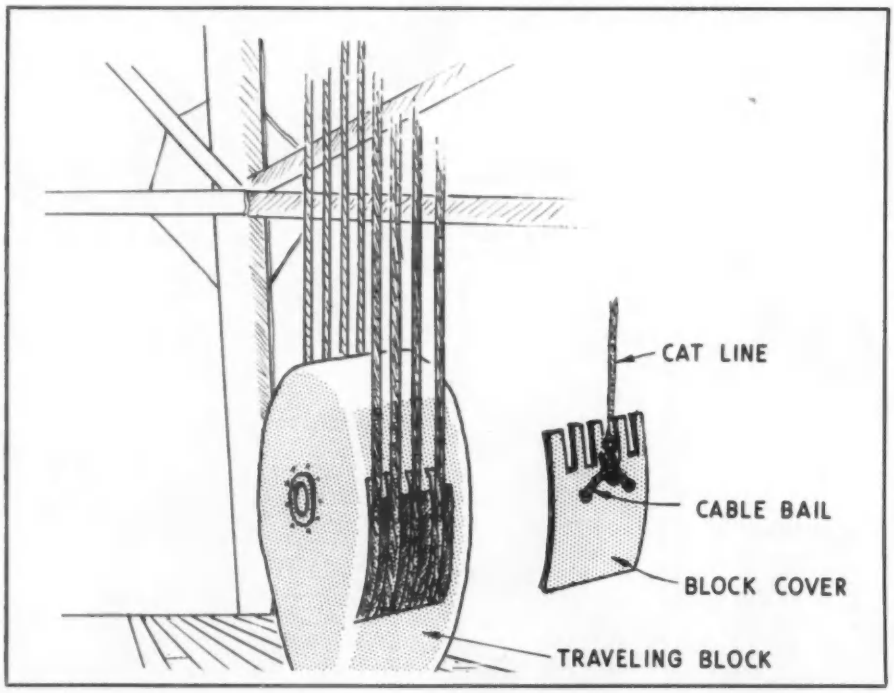


## Bails on Block Covers Ease Handling

It usually is a cumbersome job to remove the traveling block covers when restringing drilling line or when changing the number of lines. To minimize the labor necessary for this job and to facilitate the handling of these covers, one operator welded bails to the covers so they could be lifted and the weight handled by the catline.

The blocks were lowered to within working distance, or partially laid on the floor, and the cover bolts removed. The cover was then lifted out of position by the catline attached to the bails.

Two ½-inch holes were drilled in the plate, a small cable inserted and fastened on the inside. A small piece of sucker rod also can be rounded and welded to the outside of the block cover to form the bails.

## Leg of Skid Provides Riser for Filling Line

Portable tanks used for water supply on a rig usually are fitted with pipe skids to aid loading and unloading. One company, after welding the skids to the tank, fastens ladder rungs to the skid on the left and uses the one on the right as a filler line.

The line is made by welding a collar into the riser near the bottom and installing a swing joint to allow for movement of the tank and line. The top of the pipe is fitted with a spout so water will drop into the tank in sight of the driller. When necessary to move the tank, the line is disconnected at the bottom and reconnected when the tank is spotted on the new location.

## Unitized Hopper and Table Facilitates Mud Mixing

A skid-mounted unitized mud hopper and table has been constructed by a Gulf Coast contractor to facilitate mud mixing and moving of the hopper. Not only is the unit attractive and convenient for adding mud materials to the system, but it is easily moved.

The rectangular unit is built

**GM DIESEL**
**CASE HISTORY No. K-255**

**OWNER:** Kerr-McGee Oil Industries, Inc., Oklahoma City, Okla.

**INSTALLATION:** 13 General Motors 2-cycle Diesel engines. Four 6-110 "Twins" drive Ideco draw works and Triplex mud pumps. One 6-71 "Twin" powers independent catworks, rotary drive and coring reel. Two GM 6-71 Diesels drive two Halliburton Cementing Pumps, one 4-71 GM Diesel powers Halliburton Mixer.

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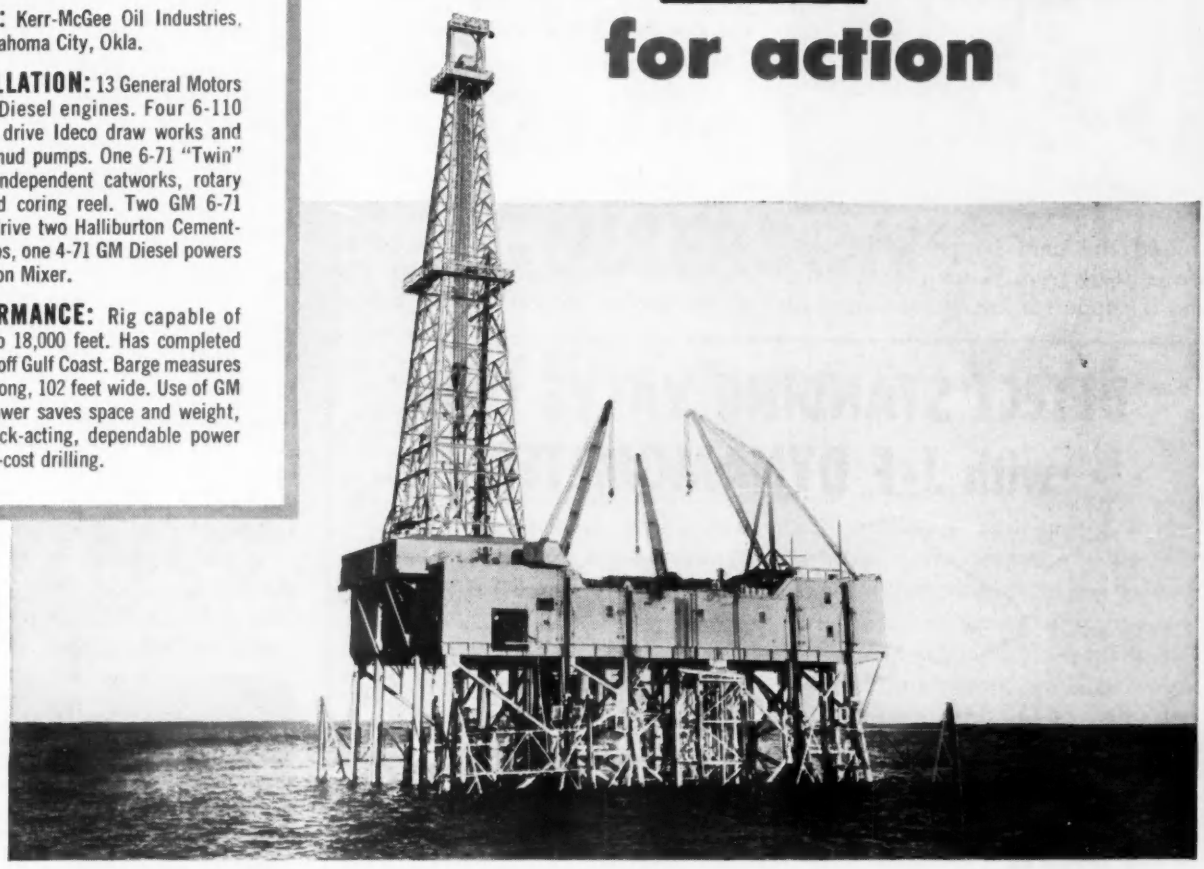
# Clears more deck for action



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And GM Diesels give you the power you need in a smaller, lighter engine. Their *2-cycle* operation delivers power on every piston downstroke for faster acceleration and a smoother power flow that helps you make hole faster, at less cost.

What's more, you always find GM Diesel factory-authorized service available when and where you need it. GM Diesel distributors—with a complete stock of *factory* parts—blanket the oil fields.

Get acquainted with the GM Diesel distributor nearest you. He'll be glad to recommend the best GM Diesel model for your drilling needs.

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GENERAL MOTORS • DETROIT 28, MICHIGAN

Single Engines... 30 to 300 H. P. Multiple Units... Up to 893 H. P.

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Berkeley
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El Cajon
DEAKINS-LANE DIESEL CO.
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**KANSAS**—Great Bend, Wichita
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Harvey
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**MISSOURI**—St. Louis
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**NEW MEXICO**—Albuquerque
HARRY CORNELIUS CO.

**NORTH DAKOTA**—Williston
SWEENEY BROTHERS

**OKLAHOMA**—Oklahoma City, Tulsa
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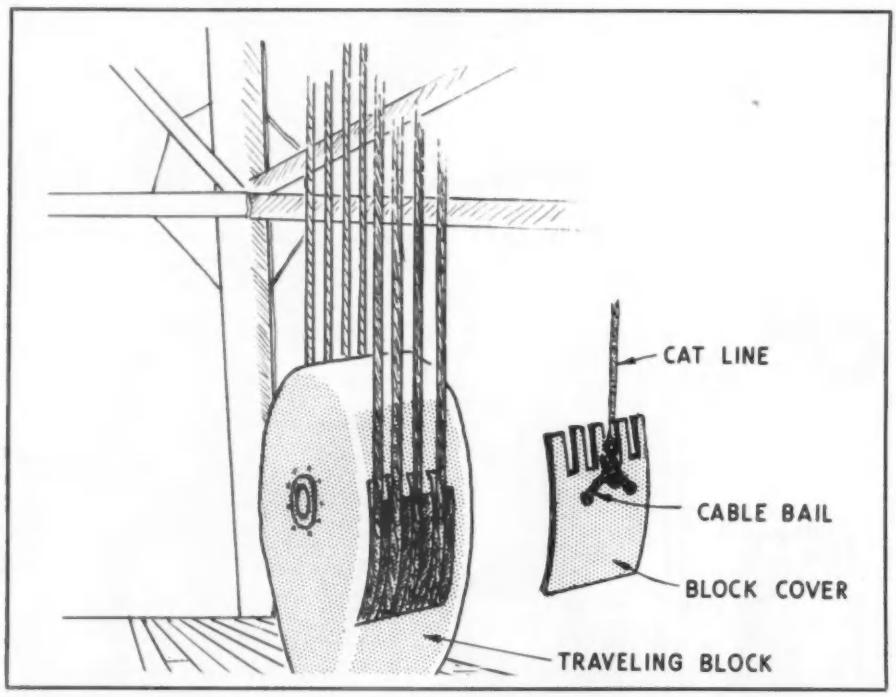


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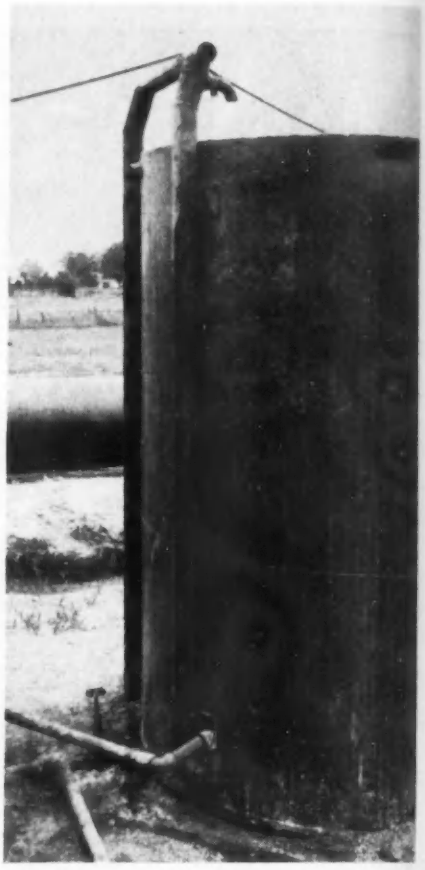

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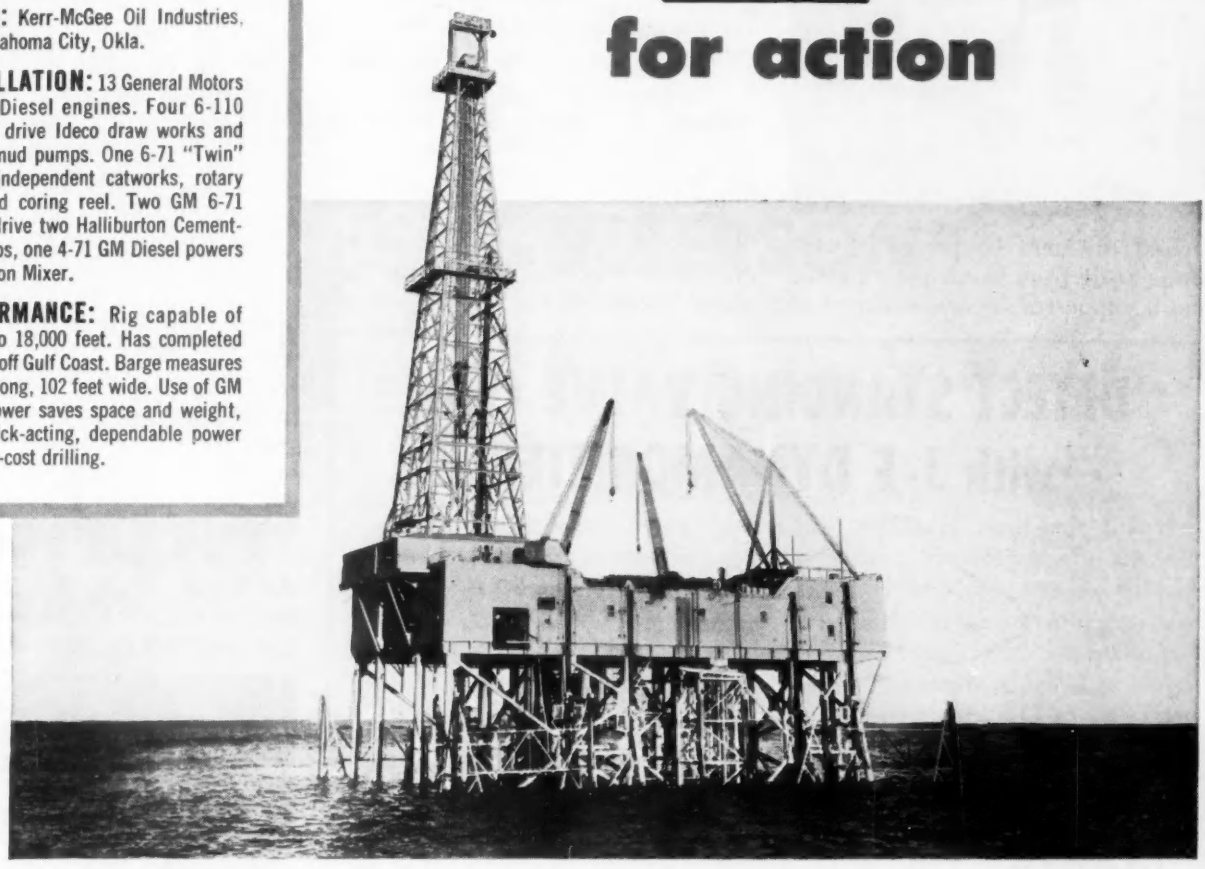

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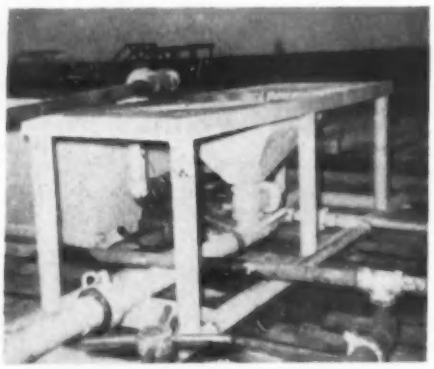


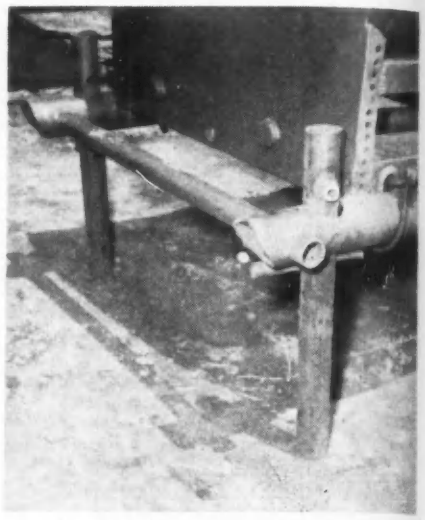
around the mud hopper. The table top is made from ¼-inch sheet metal and is supported by a skid-mount of 3-inch pipe. The entrance and discharge pipes of the hopper are secured to the skid mount.

## Rig Adjustable Legs To Keep Doghouse Level

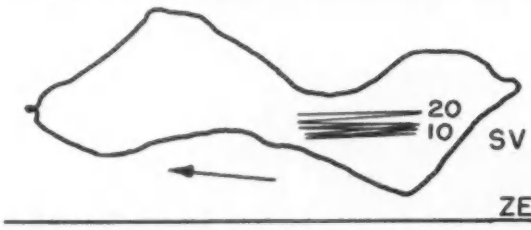
When one end of the tool doghouse is attached to the derrick floor and the ground is uneven, a simple set of adjustable legs may be made to level the doghouse.

The legs are made by cutting out a 3-inch hole in the 4-inch skids of the doghouse. Two-inch pipe with flat plates welded on the bottom are inserted into the holes. Holes are cut in the legs for pins to make the adjustment. One pin is fastened securely on top to keep the leg from falling out and one is used to adjust the height.

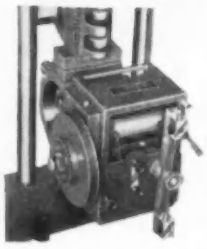
When the house is being loaded, the leg is telescoped up and the pin inserted in the bottom hole to keep the leg out of the way.




# DETECT STANDING VALVE LEAK with J-F DYNAMOMETER




## Increase in Load Shows Standing Valve Leak in Just 20 Seconds!



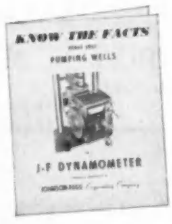
The load curve above is based on an actual J-F Dynamometer test made on a producing well. To make this test, the pumping unit is stopped on the downstroke after the traveling valve has opened. If the standing valve holds, the load remains constant. If the standing valve leaks, the load on the Dynamometer will increase within 20 seconds (as shown above), because not only the weight of the sucker rods is measured, but also a part of the fluid load.

**OTHER J-F DYNAMOMETER TESTS PROVIDE VITAL FACTS TO HELP YOU**

- Detect poor counterbalance
- Stop pulling "green" pumps
- Increase production efficiency
- Reduce sucker rod failures
- Select proper size equipment
- Establish operational control

***VALUABLE INFORMATION***

Here are two bulletins you can use. One describes the J-F Dynamometer and how it operates. The other explains the instrument's use in checking pumps. Call or write for your copies.

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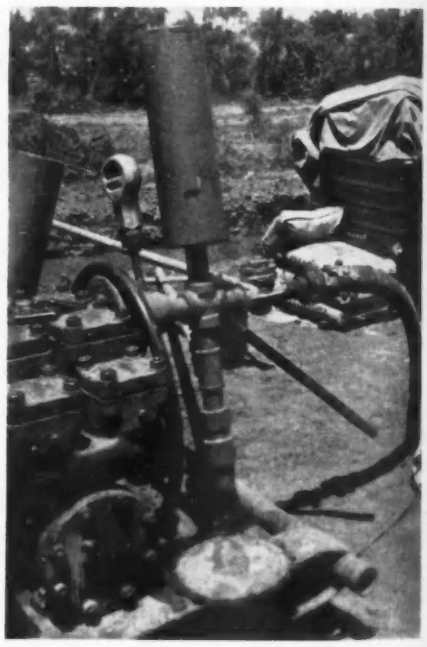
*Engineering Company*

**54th & Garnett Road**
**P. O. Box 7157**

**Phone Riverside 2-3337**
**Tulsa, Oklahoma**

*Oil Field Pumping Specialists*

## Simple Surge Chamber Prevents Pump Pound

If the auxiliary mud pump is pounding on a rig, simply replace the tee on the discharge line with a cross and screw a welded-up pot in the top connection to stop all noises. Make the surge chamber in an hour's time. Cap one end of a 6-inch length of pipe and weld a 2-inch connection onto the other end. Then screw it into the top of the cross and provide an air cushion for the surges of the pump.

# CHANGE SETTING IN SECONDS!

**Type A Controller**

## On The Versatile GUIBERSON TYPE A CONTROLLER

Adjustment for intermittent production at any given interval is just that quick on this Guiberson built unit. Lift the cover, set the adjusting screw at the point desired and the job is done. A series of fixed tabs on the revolving drum are spaced for different time cycles — five minutes, seven minutes, ten minutes, twelve minutes and other cycles that might be required. A broad range of injection intervals is provided, from a minimum of five minutes to a maximum of one injection per revolution of the two-hour clock. Accurate timing of the injection period is obtained by a simple screw and each cycle repeats with extreme accuracy. There are no loose pins or tiny adjustment parts — no special tools are required.

Extremely versatile, the same unit is easily adapted to continuous or intermittent gas lift production, purging, down-steam or up-stream pressure control of tubing or casing, tubing control, casing control, or combination tubing and intermitter control. In any of these applications the controller has a very low "on-off" operating differential. Pressure adjustments may be made very accurately, conveniently; and the control is positive. The entire unit is built of corrosion-resistant materials; is compact yet accessible, light but strong, extremely sensitive though sure in operation.

- 2" Line Pipe Threads.
- Cast Steel Body.
- 3,000 psi Test Pressure.
- 1,500 psi Working Pressure.
- Stainless Steel Stem.
- "TEFLON" Stem Packing.
- "COLMONOY" Ball and Seat.
- Steel Drip Chamber with Monel Screen.
- Corrosion Resistant Materials in Controller Parts.
- Weather Proof Aluminum Cover.

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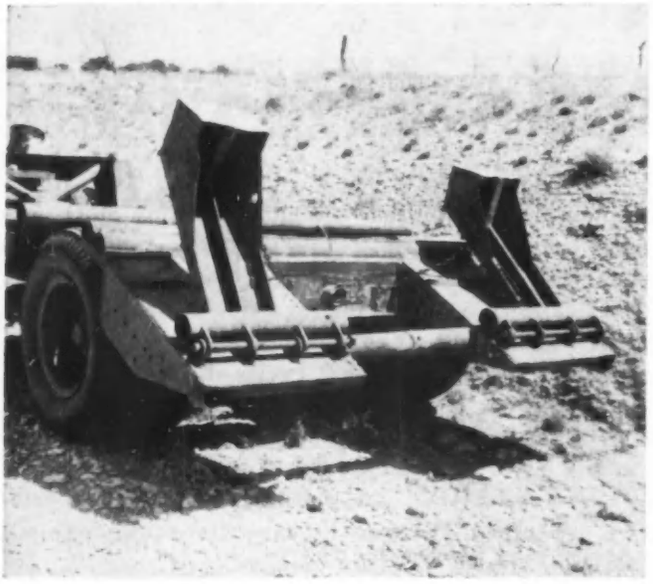
# PRODUCTION HINTS

These **How-To-Do-It** Ideas Can Save You Money



## Shop-Made Folding Ramps Speed Tractor Loading

A shop-made ramp attached to the back of a trailer makes it easy to load and unload track-type equipment quickly. Salvaged quarter-inch plate and other scrap material usually found around the yard are used in fabrication.

The ramp is made in two sections. The top one is welded onto the trailer frame, and the lower section is hinged to it by means of three-quarter inch rod passing through pads as shown. Lengths of 3-inch pipe form the upper part of the ramp and protect trailer tires. Cleats are welded onto the face of both sections.

Each movable section is made by building up plate material so that it is strong, yet light enough for one man to fold up after the tractor is loaded. Tail lights are installed on each rear corner.

**How-To-Do-It Ideas Earn Money, too!**

**$10**—World Oil editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of that latest idea and send it in with a picture or drawing of the installation . . . if accepted, $10 will be yours. Send those money-making ideas today to Hints Editor, World Oil, P. O. Box 2608, Houston 1, Texas.

## Make Pumper-Trailer Hitch from Scrap

An economical and extremely durable bumper-trailer hitch can be made with very little trouble.

The pumper who put it on his trailer made it from a discarded 1½-inch oil well pump plunger and some ¼-inch steel plate. The plunger was cut to length and spot welded to brackets made of ¼-inch steel plate which were bolted to the frame of the truck.

The hitch consists of two pieces of plate about five inches long and three inches wide. These were welded, one above the other at the center of the plunger. A one-inch hole was burned through both pieces to allow a pin or ball hitch to be installed.

Call your
**BUTLER**
Distributor for
precision-made . . .

# TIGHT CLEAN

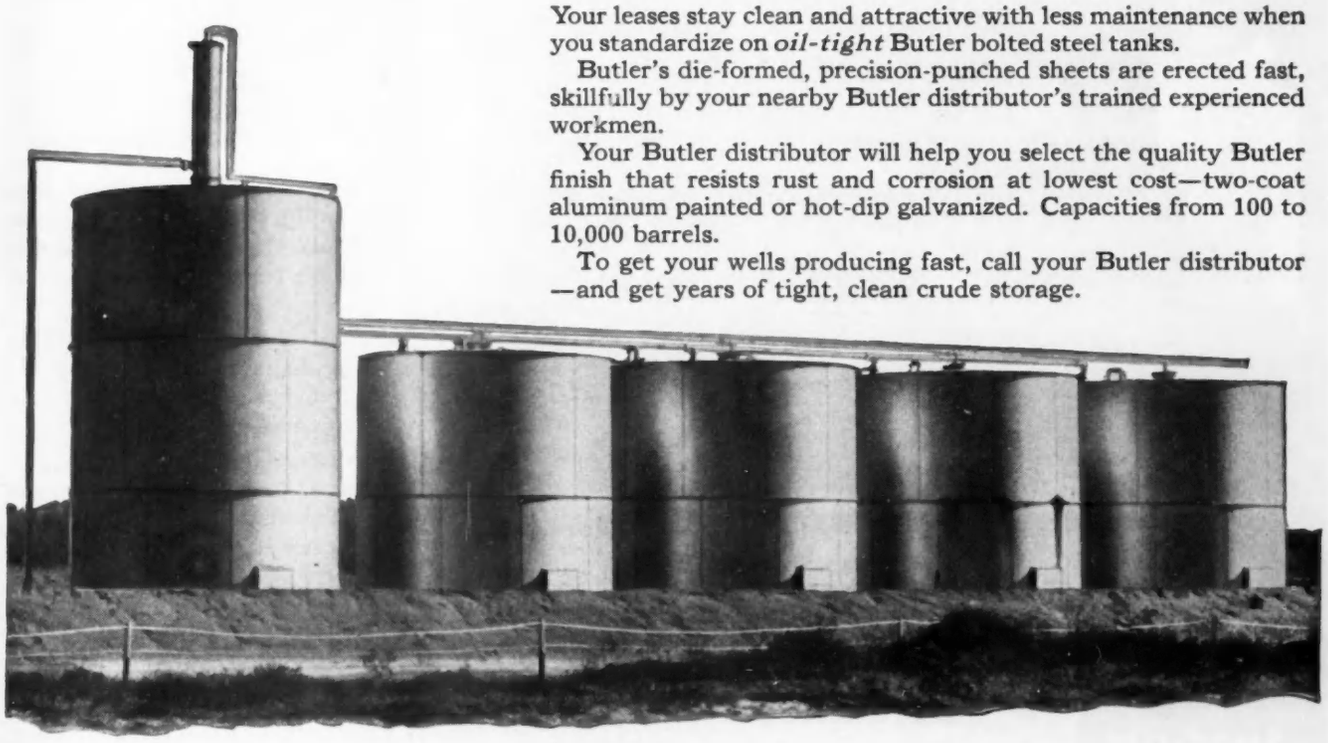
## bolted steel oil tanks

Your leases stay clean and attractive with less maintenance when you standardize on *oil-tight* Butler bolted steel tanks.

Butler's die-formed, precision-punched sheets are erected fast, skillfully by your nearby Butler distributor's trained experienced workmen.

Your Butler distributor will help you select the quality Butler finish that resists rust and corrosion at lowest cost—two-coat aluminum painted or hot-dip galvanized. Capacities from 100 to 10,000 barrels.

To get your wells producing fast, call your Butler distributor —and get years of tight, clean crude storage.



**UNION TANK AND SUPPLY COMPANY**

| | | | |
|---|---|---|---|
| Abilene, Texas | Nocona, Texas | Oklahoma City, Okla. | Denver, Colo. |
| Alice, Texas | Odessa, Texas | Tulsa, Okla. | Fort Morgan, Colo. |
| Beaumont, Texas | Hobbs, N. M. | Great Bend, Kan. | Sterling, Colo. |
| Dallas, Texas | Dubach, La. | Plainville, Kan. | Casper, Wyo. |
| Fort Worth, Texas | LaFayette, La. | Russell, Kan. | Newcastle, Wyo. |
| Houston, Texas | New Orleans, La. | Wichita, Kan. | Powell, Wyo. |
| Kilgore, Texas | Ardmore, Okla. | Kimball, Nebr. | Williston, N. D. |
| Midland, Texas | Cushing, Okla. | Sidney, Nebr. | Glendive, Mont. |

**AMERICAN PIPE AND SUPPLY COMPANY**
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**BUTLER MANUFACTURING COMPANY**
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**Manufacturers of Oil Equipment • Steel Buildings • Farm Equipment • Dry Cleaners Equipment • Special Products**
Factories located at Kansas City, Mo. • Galesburg, Ill. • Richmond, Calif. • Birmingham, Ala. • Houston, Texas • Minneapolis, Minn.

## Turnbuckles Brace Pulling Unit

Whenever a person thinks of a turnbuckle he usually thinks about applying tension, however, uses can be found for turnbuckles in compression as shown by this illustration. Here, in order to use an existing dead man, a pulling unit was tied down at the rear instead of at the sides. As a result of this tie-down, the unit vibrated excessively at the front whenever the swabbing line was being withdrawn from the well. To reduce this vibration, turnbuckles were used as jacks on the sides of the unit.

In reworking the turnbuckles for this application the eye on one extension of the turnbuckle was sawed off and a small steel plate was welded

in its place. The turnbuckle was then bolted to the frame with the plate set on a plank and pressure was applied to the unit frame by unscrewing the turnbuckle.

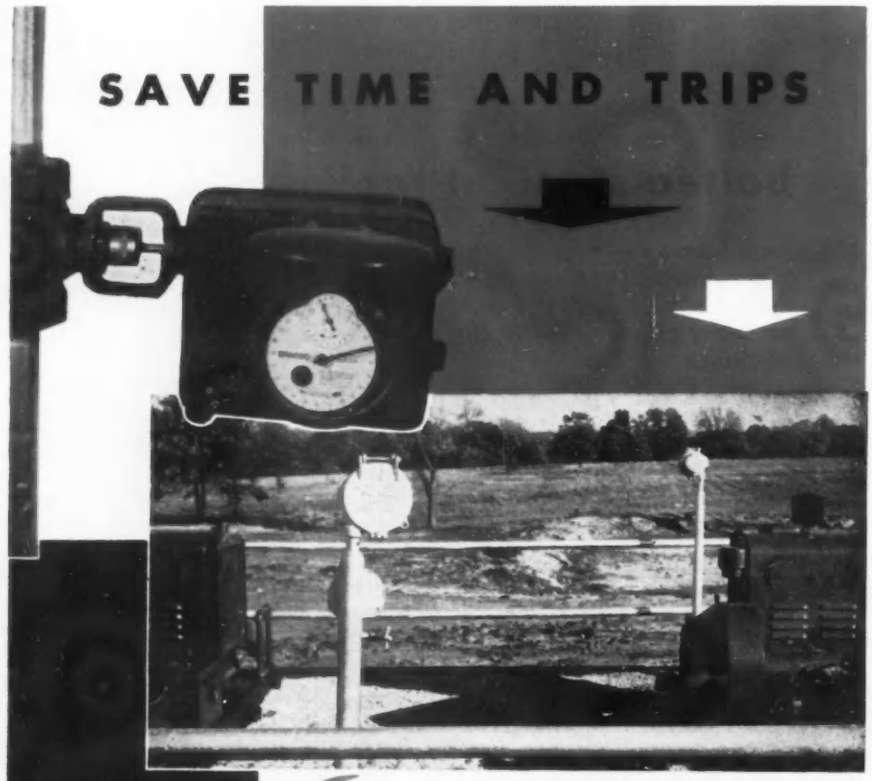
In this particular instance vibration was eliminated almost completely and turnbuckles are now used as a regular feature of the unit.

This case helps to open up a large area for application of turnbuckles where a compressive force is desired which is not sufficient to warrant use of a jack.

## Mount Bull's Eye to Save Field Signs from Hunters

Each year during hunting season, field signs are likely to take a beating from eager hunters zeroing-in their sights. An Ohio oil field superintendent mounted a bull's eye on the company's Walker Dome, Wyo., signs to oblige the hunters. The area around the field is rich with game such as elk, deer, bobcats, antelope and an occasional mountain lion.

Hunters use the bull's eye, a much better target than the sign. Both the field operators and the hunters are happier. From the accuracy of the shooting, apparently the target improves the aim, too.


with ENARDO CLOCK SHUT-OFF VALVES and TIME CYCLE SWITCHES

The Enardo Clock Shut-off Valve is designed to control the flow of low-pressure gas or liquid and to shut off the supply at a pre-determined time. Enardo Clock Shut-off Valve fills the need for a completely automatic and dependable valve mechanism for use in gas or liquid flow lines where operating pressure does not exceed 100 lbs. This valve is particularly adaptable for use on fuel lines to engines, boilers and furnaces.

The Enardo Time Cycle Switch is designed to ground magneto on stationary engines or pumping units. They shut the engine down at a pre-determined time, "Saving time and trips." The same clock mechanism is used to operate both the Shut-off Valve and the Timer.

The Enardo Clock Shut-off Valve and Time Cycle Switches can be set to close after any number of hours up to 22 on the 24 hour Models or 11 on the 12 hour Models.

Write for information on
Model "W" clock shut-off valves Bul. 10-05
Model "A" time cycle switches Bul. 10-01

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# first

WITH

# SPECTROLOG

Quantitative analysis for origin of gases in drilling muds by spectroscopy.

PATENTS PENDING ON EQUIPMENT & PROCEDURES

Petroleum Service

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SAN ANTONIO, TEXAS

ATTENTION: Geologists, Petroleum and Electrical Engineers, Physicists, and Electronic Technologists. Employment opportunities exist. Contact us.

# REDA PUMPS

## FIRST CHOICE for Secondary Recovery Water Flooding...

The lower the expense of producing source water from wells for water flooding operations, the greater the ultimate profit.

Reda Pumps for source water wells provide many ways for lowering these production costs.

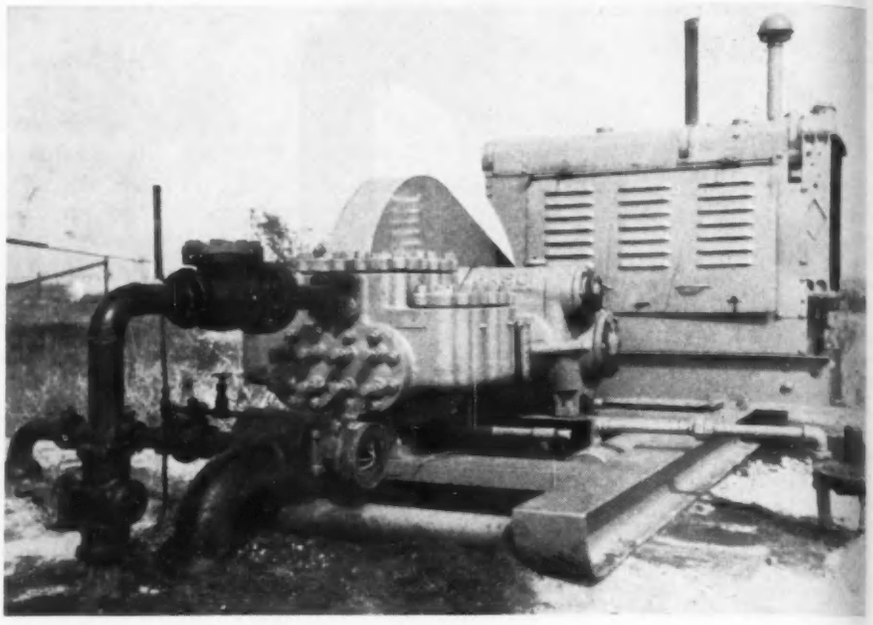
Improved design and longer operating life *lower* the cost of labor per barrel, *lower* the cost of maintenance per barrel, *lower* the investment cost per barrel, *lower* the cost of fluid per barrel.

Also the ability of Reda pumps to produce greater volumes in limiting casing sizes and from greater depths often reduces the number of source water wells required.

Reda engineers have long been associated with water flooding operations and are fully qualified to assist operators in discussing their source water requirements.

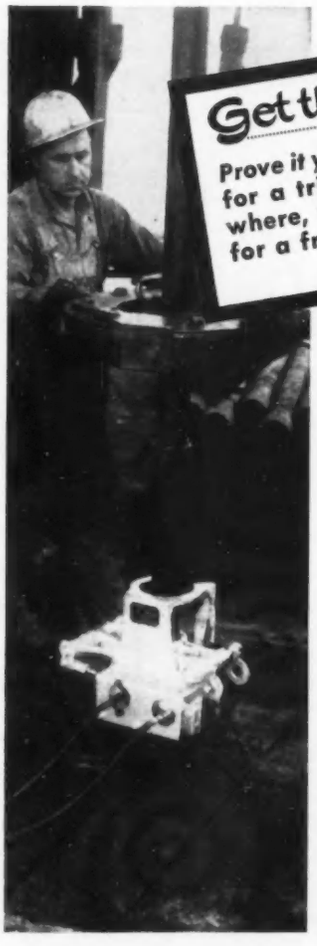
**REDA**
**PUMP COMPANY**
**BARTLESVILLE, OKLA.**



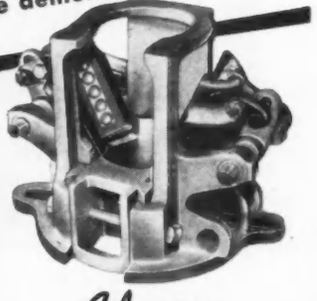
## Mercury Switch Shuts Down Engine

When booster pumps are used to pump crude into main pipe lines, time clocks cannot be set to shut down the engine at the exact moment a tank is emptied. Either oil is left in the tank or air enters the line, causing trouble with air locks. More seriously, it has been found in recent years that even a small amount of air multiplies the corrosion rate inside the pipe line many times.

**Get the best by test!**

**Prove it yourself—use the ADVANCE for a trial period, anytime, anywhere, without obligation. Write for a free demonstration.**



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*air powered*
**TUBING SPIDER**

The **ADVANCE** is the first and only complete Automatic Air-powered Tubing Spider. It is also available for hydraulic operation. It is full of features that you'll not find in any of its imitations.

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**2853 Cherry Ave.,**
**Long Beach 6, Calif.**
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Mid-Continent Rep: Hillman-Kelley
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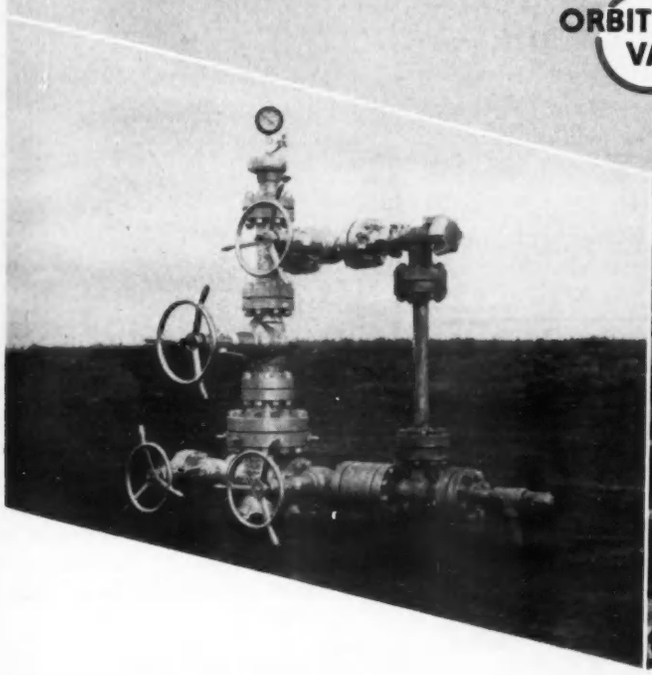
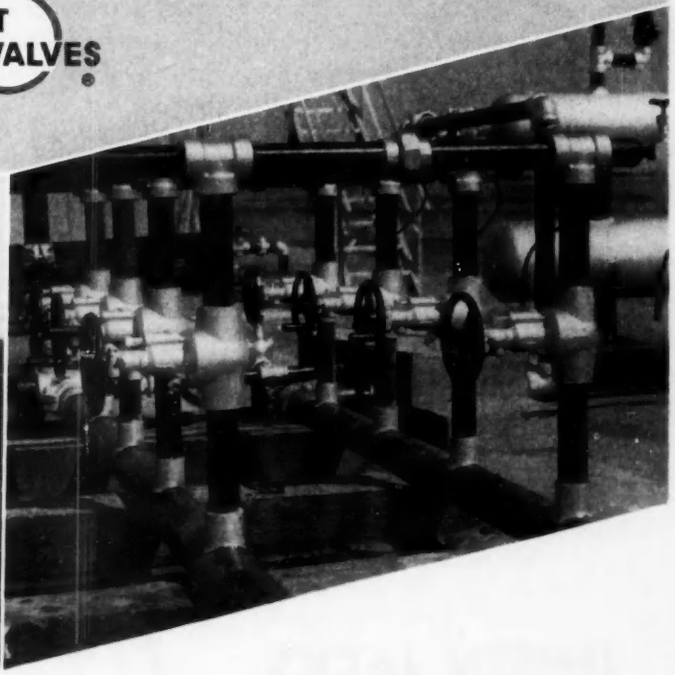
# Safe from Well to Storage

ORBIT VALVES®





# POSITIVE SEATING
# Orbit Production Valves

Positive closure in Orbit Valves is insured because there is no distortion of metal to obtain closure; Orbit's yielding body seat always resists further compression of the seating segment by pushing back against it.

Friction between the body seat and the face of the core has been eliminated because of the free movement of these parts. Contact of the major seating surfaces is obtained by the "rolling" action of the seating core into the body seat.

Orbit's streamlined design permits reduced weight and allows installation in minimum space. For longer periods of uninterrupted service use ORBIT valves —they give longer continuous heavy duty service.

*A full range of sizes are available beginning with 1", to and including 4". Test pressures 1,000 to 10,000 lbs. API Class. Screw and Flange end.*

## ORBIT VALVE COMPANY

**P. O. BOX 699** **TULSA, OKLAHOMA**

**BRANCHES**

**HOUSTON, TEXAS**
407 Velasco
(Serving the Gulf Coast)

**CASPER, WYOMING**
247 West First Street
(Serving the Rocky Mountain States and Canada)

**ODESSA, TEXAS**
402 West County Road
(Serving West Texas)

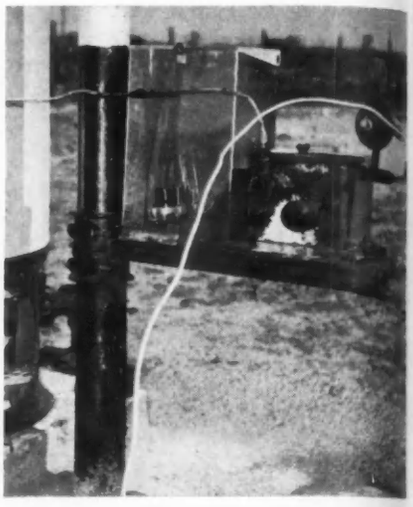
Instead of using a float, one company puts a mercoid float switch on the suction line of the pump. When the tanks are pumped out, it grounds the circuit of the engine and prevents air from entering the line.

The usual float arrangements which drop into a seat when the level goes down in the tank are installed at each of the tank batteries. When the vacuum increases on the suction of the pump, a small amount of gas comes out of solution in the float chamber and shuts down the pump.

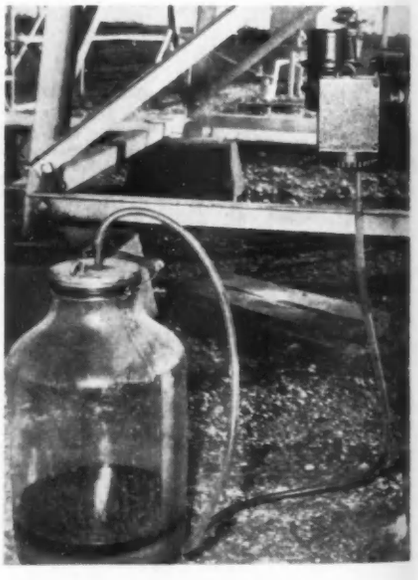
## Elevated Chemical Feeder Aids Loading, Adjustment

Because of the small size of chemical feeders, especially when installed on or near the ground, loading, cleaning and maintenance are troublesome jobs. One operator elevates these feeders to a convenient working height, however, by mounting them on the gas line of the separator.

A short 2-inch length of pipe is welded to a pipe clamp. The frame for the feeder base, which is made of angle iron, is welded to the pipe. The clamp, adjusted to a convenient height on the gas line and fastened in position, can be removed easily when necessary.



Possibility of breaking out gas and injection lines is not as great with this permanent type of installation.



## Increase Sample Sizes With Shop-Made Apparatus

When one operator found it necessary to obtain larger samples from the flow line, he removed the 2000 cc container on the original sampler and welded a piece of metal tubing to the outlet. On this he slipped a few feet of plastic hose which he ran into a three-gallon jar through a small metal tube soldered to the lid. A vent was punched in the lid and protected by a piece of bent tubing which also was soldered in place. Proportions of oil and water were obtained by measuring the outside of the jar with a rule.

**JENSEN JACKS**

**MORE *Service* . . . LESS *Servicing***

Profits from any well depend largely upon the efficiency of your equipment above ground . . . and that's why producers everywhere are standardizing on reliable JENSEN JACKS. They're engineered to give MORE service with LESS servicing. Most adjustments, from counterbalancing to changing gear reductions, can be made easily and quickly in the field by one man.

Trouble-free service records established by JENSEN JACKS are available . . . and we would like to tell you about them. Write us or see your JENSEN Dealer.

JENSEN JACKS

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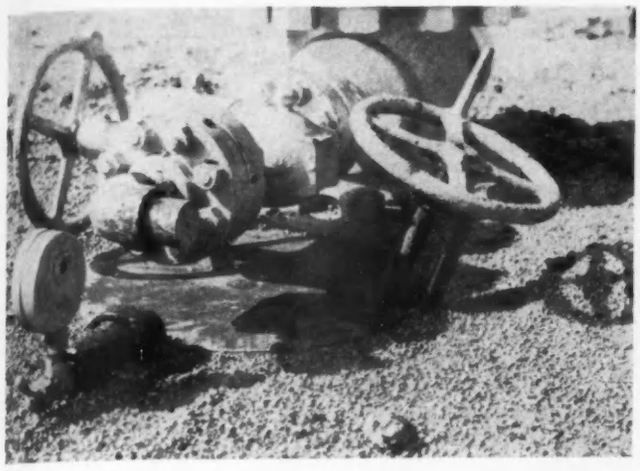
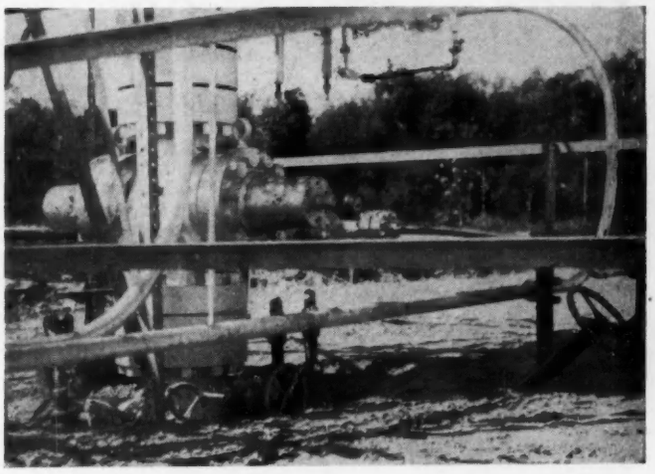
**25 Broad Street, New York City**





## Casing Valve Stem Extensions Ease Operations

Occasionally when a high pressure well is completed a long christmas tree, made up of a number of valves, is required. Often some of the valves are well below the ground level, making operation difficult.

One operator solved this "sunken valve" problem and eliminated the cellar by using a length of 20-inch casing around the entire tree with an extension on the valve stem of the lower valve. The valve was situated to allow the extension to run inside the casing to a bracket at the ground level as shown in the first illustration. Note also the cover for the casing which prevents debris from falling inside.

When a situation arises which prevents the valve stem from running inside the casing surrounding the tree, a second method may be applied. This operator cut a hole in the casing to permit the valve stem extension, a piece of 1½-inch pipe, to come up the outside. Over this he slipped a piece of 2½-inch pipe as shown in the second photograph. The 2½-inch pipe was then welded to the 20-inch casing around the hole. This provided a sealed sleeve, free of dirt, etc., in which the 1½-inch extension could operate freely.


NO MORE BURNED STUFFING BOX PACKING...

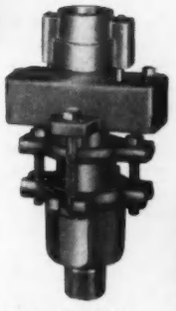
USE A

HERCULES OIL RESERVOIR UPPER GLAND

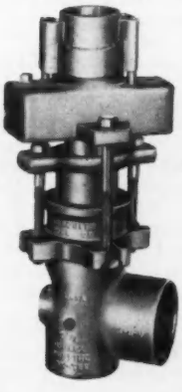
The HERCULES Oil Reservoir Upper Gland was designed primarily for "problem" wells which pump-off and burn the stuffing box packing. The polished rod moves through the oil in the reservoir which lubricates and helps cool it. The reservoir capacity is one fluid quart. The Split Cone Packing Ring (located between the Oil Reservoir Gland Body and Cap) is used to control the oil film on the polished rod on the "up stroke." On the "down stroke" it wipes off the excess oil and the dust or sand which invariably collects on the rod. The Reservoir Gland Cap channels the excess oil and dirt back into the oil reservoir. The dirt will then "settle out" and can be removed from the reservoir through the drain plug.

DESIGNED AND RECOMMENDED By the men who use them

SOLD AT ALL SUPPLY STORES

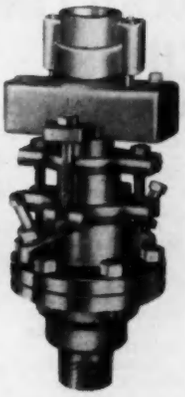


"REG. TYPE"



"TEE BASE TYPE"

The three illustrations show all the famous HERCULES Duplex Polished Rod Stuffing Boxes equipped with the New Oil Reservoir Upper Gland.



"TYPE D.P." (Double Packed)

SEE IT AT YOUR SUPPLY STORE

HERCULES TOOL COMPANY

SINCE 1924

*Manufacturers of Oil Field Equipment*

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# What's Happening

## AMONG MEN IN THE INDUSTRY

Charles R. Brown

Thomas M. Dailey

**Charles R. Brown,** vice president of **Tide Water Associated Oil Company,** has been named assistant general manager of the Central division with headquarters in Tulsa. With Tide Water since 1917, Brown was elected vice president in 1948 and became assistant general manager of the company's West Coast operations in 1954. **Thomas M. Dailey, Jr.,** has joined Tide Water as manager of the Economics department and **Moody Covey** has been appointed safety supervisor for the company's Southern division. For the past nine years Dailey has been petroleum economist for Humble Oil & Refining Company in Houston. Covey joined Tide Water in 1950 and has served as safety engineer in the company's Central division.


**CUT STUCK SAND LINES INSIDE TUBING**

**KINLEY SAND LINE CUTTER**

***M. M. Kinley Company Licensees***

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OKLAHOMA CITY
Rainbo Service Co. - - - ME 4-2131, ME 2-3045
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Hudson-Eads, Inc. - - - 2-3767, 2-8584, 3-4690
CASPER, WYOMING
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GLENDIVE, MONTANA
C. A. White - - - - - - - - - - - - EMpire 5-3833
FORT MORGAN, COLO.
C. A. White - - - - - - - - - - - - - - - - 919


**R. D. White** recently resigned as assistant chief geologist of The California Company at New Orleans to accept the position of chief geologist of the **Plymouth Oil Company.** His headquarters will be in Sinton, Texas. White, who also has been with Standard Oil Company of Texas, has served as a geologist in the Texas Gulf Coast, West Texas, New Mexico, Rocky Mountains, Louisiana, Mississippi, Alabama, Kentucky and in other areas.

•

**Frank D. Lortscher,** elected to the board of directors of the **Signal Oil and Gas Company,** presently holds the position of manager of purchases and stores. He has been with the company 28 years in various capacities, both in Long Beach, Calif., where he joined the company and in the home office in Los Angeles where he maintains his present office. He served as president of the local Purchasing Agents Association during 1952-53, and has served a term as national chairman of the Oil Buyers Group of the National Association of Purchasing Agents.

F. D. Lortscher

•

**Texas Crude Oil Company** announces the addition of **R. E. Kellerman** as a new partner in the firm. Kellerman joined the company in 1952 as West Texas district engineer. Later promoted to chief engineer, he has served as general manager of the company's headquarters in Fort Worth since 1954. Prior to joining Texas Crude, he was with Dowell Incorporated, Shell Oil Company and Republic Natural Gas Company. Other partners in the firm are Ted, Stanley and Charles Weiner.

R. E. Kellerman

•

**Skiles Oil Corporation** directors have announced the promotion of **Ross Phar** to assistant vice president. Phar, who joined the Skiles organization in 1948, has had administrative supervision of the Production and Land departments for the past 15 months. **Kenneth L. Martin,** who recently joined the Skiles staff as chief accountant, has been appointed assistant treasurer.

•

**Ben C. Belt,** Houston industrialist and civic leader, will head the Texas Research League as chairman in 1956. He will succeed **Hines H. Baker,** president of the Humble Oil & Refining Company and one of the League's founders. Baker will continue with the League as a member of its Executive Committee. Belt recently retired as vice president of Gulf Oil Company after a long career as geologist and oil production executive.

**Continental Oil Company** announces the promotion of **E. E. Fickinger,** Midland geophysical supervisor, to Midland division geophysicist, succeeding **J. E. Findley** who has been promoted to the newly-created position of Midland division exploration manager. Fickinger joined Conoco in 1947 and served on company geophysical crews in several states before his promotion to geophysical supervisor in 1954. Finley has been with Conoco since 1948. He became division geophysicist at Roswell, N. M. in 1952 and transferred to Midland in 1954 in the same capacity.

•

**Harold F. Parsons,** recently appointed New York representative of **Crown Central Petroleum Corporation,** will be responsible for wholesale sales of the company's products. Parsons retired as assistant vice president of Tide Water Associated Oil Company in 1954 after more than 36 years of service.

•

**Ball Associates,** oil and gas consultants of Washington, D. C., recently announced the association of **Alan M. Bieber,** former independent geologist; **Richard H. Fulton,** formerly with Midstates Oil Corporation; and **Alexander S. Wyner,** mining engineer and geologist.

•

**L. F. Shiplet's** appointment as division manager of West Texas division, **The Texas Company's** Producing department, and two other key promotions in the division staff at Fort Worth have been announced. Shiplet, assistant division manager, will succeed **C. B. Williams,** who is retiring after 14 years as division manager. **O. F. Sebesta,** general superintendent of drilling and production, will be advanced to assistant division manager. **J. A. Hale,** assistant to division manager, South Texas division, Houston, has been promoted to assistant division manager, West Texas division. Shiplet started with Texaco in 1927 as a roustabout. He was promoted to general superintendent at Midland in 1945 and transferred to Fort Worth in the same position in 1947. He was advanced to assistant division manager three months later. Sebesta joined the company as a roustabout in 1938. He was made general superintendent of drilling and production in 1952. Hale began with the company as map boy in the Oklahoma division in 1927. He rose through various jobs to assistant to division manager (Industrial Relations). In 1952 he was made assistant to division manager, South Texas division.

•

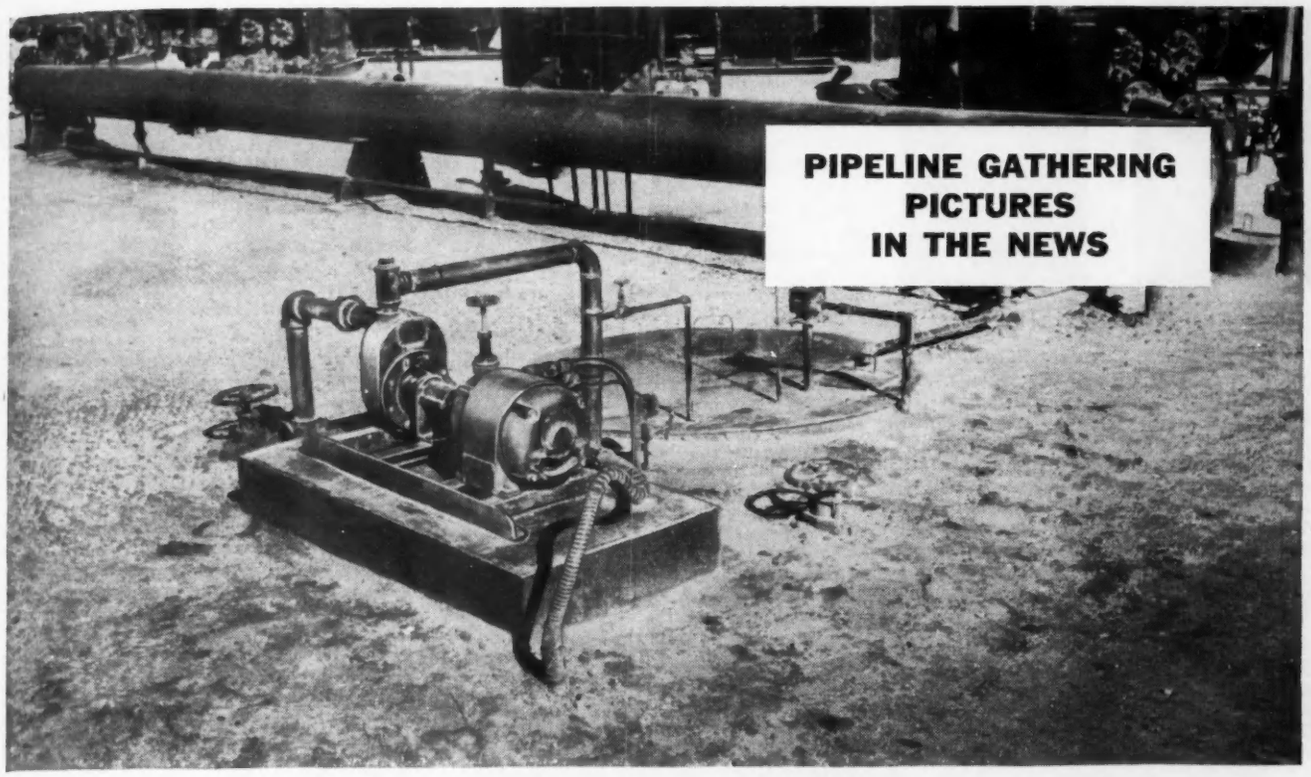
**Kendall (Sandy) Cashion** recently accepted a position as geologist with **Bert Fields,** an independent in Dallas. Cashion formerly was with Murphy Corporation in Denver.

•

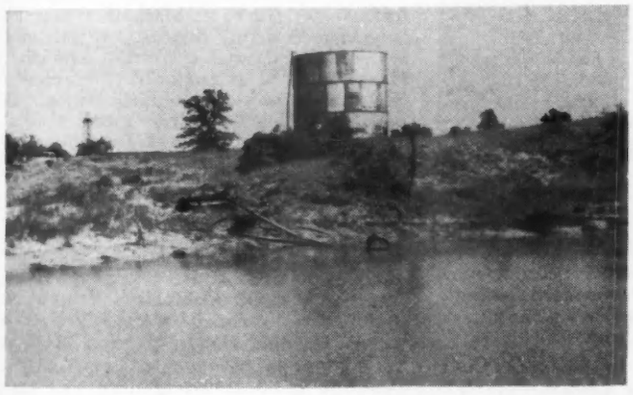
**R. W. Chase** has been transferred by **Gulf Oil Corporation** from Salt Lake City to Casper, Wyo., as area exploration manager. He replaces **H. D. Bedford** who was appointed Rocky Mountain zone manager of exploration.

•

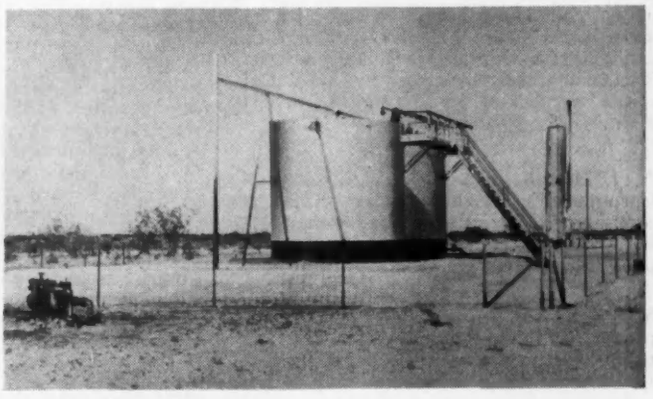
**Harold Freeman,** Pauls Valley, Okla., has been appointed to the **Oklahoma Corporation Commission,** succeeding **Roy O. Weems.** At a Commission meeting, **Ray C. Jones** was reelected chairman, and **Wilburn Cartwright,** vice chairman.



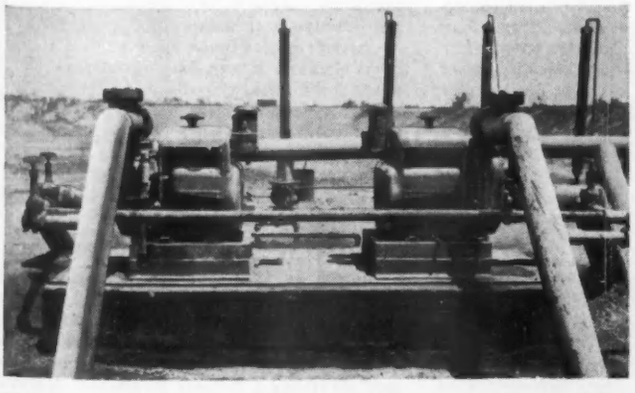

**OIL RECOVERY**— This float-switch-controlled, motor-driven, 1½-inch Marlow self-priming centrifugal pump transfers oil from a sump to storage tanks serving the main pipe-line pumps. The sump serves as an accumulator for crude oil from outlying lease tanks and also for recovering stuffing-box leakage from the pipe-line pumps. Self-primers are reliable for automatic operation.



**WATER SUPPLY** — This 2-inch Marlow self-primer is pumping water into the tank in the background which supplies water by gravity flow to the pumping station on the other side of the hill.



**CRUDE OIL GATHERING** — This 2-inch Marlow self-primer is pumping crude oil to storage tanks. The engine is run by natural gas, allowing it to run unattended for long periods of time.



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Thos. A. Hendricks

John G. Voight

**Thos. A. Hendricks**, formerly division geologist for **Stanolind Oil and Gas Company** in Fort Worth, has been transferred to the company's general office in Tulsa as superintendent of foreign exploration. **John G. Voight** has been named division geologist for the North Texas-New Mexico division, succeeding Hendricks. Voight moves to Fort Worth from Tyler, Texas, where he was district exploration superintendent. Hendrick's new duties will involve general supervision of foreign exploratory activities other than in Canada.

•

**Ora C. Collins, Jr.**, former production engineer with Petroleum, Inc., at Great Bend, Kansas, has joined the **Socony-Vacuum Oil Company** of Venezuela as petroleum engineer. His offices will be Caracas.

•

**Falcon Seaboard Drilling Company** announces four personnel changes in their Tulsa office: **C. M. Bailey**, secretary, has been named comptroller, after 13 years service with the company; **T. N. Law, Jr.**, has been named assistant secretary; and the firm's chief accountant, **J. R. Toussaint**, has been named assistant treasurer. **R. N. Caffey**, a member of the accounting department, will be assistant to Toussaint.

•

**A. J. Howell**, geologist in **Midstates Oil Corporation's** Oklahoma City office, has been named district geologist for the Oklahoma district. He has been with the company seven years.

•

**Morris S. Lee**, former vice president and production superintendent of **Lee Oil Company**, has been elected president of the firm. He succeeds his father, the late **Hily W. Lee.**

•

**Eugene Barr**, senior geologist for **Sunray Mid-Continent Oil Company** in the Wichita, Kansas, district office, has been transferred to Denver, as district geologist. Barr has been on the Wichita staff eight years. **Don Rector**, geologist for Sunray Mid-Continent in the Tulsa office, has been transferred to Wichita, as a geologist in the district office.

•

**Captain George Larimer** recently was named port captain at **Sun Oil Company's** tankship fleet headquarters in Marcus Hook, Penn. He succeeds Captain Robert J. Ball, recently retired. Joining the Sun fleet as an able-bodied seaman in 1938, Larimer came up through the ranks and won his first command in 1944. In 1946 he was made assistant marine personnel manager ashore, becoming assistant port captain in 1949.

•

**Arthur M. Sherwood**, newly-appointed assistant secretary of **Socony Mobil Oil Company, Inc.**, has served as legal counsel since joining the company in 1954. He previously was associated with the law firm of Shearman & Sterling & Wright, New York.

**Southwest Gas Producing Company, Inc.**, recently announced that **Richard F. Cox**, former chief engineer, has been appointed general production superintendent. In his new capacity, he will supervise and coordinate production and drilling operations from the company's main office in Monroe, La.

•

**Jack O. McCall** was appointed assistant to the president of **The Louisiana Land and Exploration Company** in November, 1955. He had been manager of the Land department for three years and continues in that capacity.

•

**Kerr-McGee Oil Industries, Inc.**, has appointed **G. Otis Danielson** manager of drilling operations in the company's Gulf Coast region. He formerly was manager of drilling operations in Kermac's Mid-Continent region which includes the Oklahoma-Texas and Rocky Mountain divisions. Danielson has been with the company since 1940. His former duties were split three ways: **George B. Parks**, general manager of production and drilling, assumed part of the duties of the office; **Norman Baxendale** became general drilling superintendent of the Mid-Continent region; and the bidding and contracting section of the region was placed under the supervision of **J. W. Bawcom.**

•

**Standard Oil Company of California** announces the election of **Asa V. Call** to the company's board of directors. A Los Angeles life insurance executive and civic leader, Call has been president and a director of Pacific Mutual Life Insurance Company since 1942. The company also announces the promotion of **Warren E. Lovejoy** to manager of the Safety division, Personnel department. He succeeds the late R. E. Donovan. Lovejoy, who joined Standard in 1924 as an estimator and personnel representative was named personnel supervisor of California Research Corporation in 1951. He was appointed assistant to the manager, Safety division, in 1953.

Asa V. Call

•

**Humble Oil & Refining Company** recently announced the following changes in its Production department supervisory personnel: **R. J. (Sport) Butaud**, roustabout gangpusher, Clear Lake Gas Plant, Gulf Coast division, was promoted to gas plant superintendent of the Neches Gas Plant, East Texas division; **Roy F. Ewing**, toolpusher, transferred from the Grand Isle district, Louisiana division, to the Hobbs district, West Texas division; and **John J. Bardgette**, district civil engineer, Anahuac district, Gulf Coast division, was transferred to the Louisiana division office as senior civil engineer. **C. A. Woolley**, associate petroleum engineer, Paradis district, Louisiana division, was transferred to the North Texas division office as associate petroleum engineer, replacing **F. E. Roberts, Jr.**, who transferred from the North Texas division office to Paradis. **J. D. Thompson**, roustabout gangpusher, Lovell Lake district, Gulf Coast division, was promoted to farm boss at Lovell Lake; **J. C. Fulks**, senior division clerk, Gulf Coast division office, was promoted to division material pusher; and **L. L. Atwell, Jr.**, junior petroleum engineer, Stratton district, Southwest Texas division, was promoted to associate petroleum engineer at Stratton.

**Paul C. Berner** has been promoted to district geologist in **Lion Oil Company's** Wichita, Kansas, district production and exploration office. He replaces **C. Elton Gore** who was promoted recently to regional geologist in the Central region. Berner joined Lion as a geologist at El Dorado, Ark., in 1953. He was transferred to Salt Lake City when the company opened a district office there in 1955.

Paul C. Berner

•

**W. F. Herbert**, who has been in foreign service for **The Texas Company** more than a year, is now assistant to division manager of South Texas division of Texaco's Producing department. Herbert was division petroleum engineer of South Texas division until 1954, when he was transferred to foreign service, Eastern Hemisphere, The Texas Company. He served until recently as manager of Technical Services for the Iranian Consortium, with headquarters in London.

•

**Husky Oil Company** has announced three promotions in the Production department. **M. F. Westfall** has been named production superintendent, **Jim Boydston** has been promoted from the position of foreman to acting district superintendent of the Cody district, and **Herbert Earnest**, production foreman for Husky at Midland, Texas, has been named acting district superintendent of the Midland district. Westfall, who joined Husky in 1952 as engineering assistant to the production superintendent, since 1954, has been acting production superintendent. Prior to joining Husky Westfall was employed by Cities Service Oil Company as district manager of the Texas district.

•

**Donald J. Munroe** and **Lee C. Smith** have been appointed assistant regional geologists in **Sun Oil Company's** Southwest Production division. Munroe will assist Dr. E. W. Hard of Dallas, regional geologist, in supervising work in the Tyler, Texas; Shreveport, La.; Jackson, Miss.; and Tallahassee, Fla., districts. Smith will assist Wallace Ralston of Dallas, regional geologist, in handling similar duties in the Texas Panhandle, West Texas and southern New Mexico. At the same time appointments were announced of **Rex Alcorn** as district geologist at Roswell, N. M., and of **Walter L. Erwin** as geologist in charge of the Tallahassee office under Munroe. Alcorn, already at Roswell, succeeds **Edward B. Wilson** who recently retired from the company after 29 years of service. Munroe began with Venezuelan Sun., Ltd., in 1926, transferring to Sun Oil and returning to the U. S. in 1928. First employed by the company as a paleontologist at Dallas in 1933, Smith was area geologist at Midland, Texas, prior to his new position. He previously had served as district geologist in McAllen, Texas, office. Alcorn joined the company as a subsurface assistant in 1948 and worked at Dallas and Midland before going to Roswell. Erwin joined Sun as assistant field geologist in 1948. He has done both development and exploratory geological work and was assigned to the Roswell, N. M., and Abilene, Texas, offices prior to his moving to Tallahassee.

F. L. Johnson

Preston E. Chaney

**Sun Oil Company** announces the appointment of **F. L. Johnson** as director of Production Research and Development, coinciding with completion of a modern laboratory at Richardson, Texas, near Dallas. **Preston E. Chaney**, formerly manager of the Beaumont production laboratory, has been appointed assistant director, succeeded at Beaumont by **H. W. Perkins. Dr. R. J. Cordell**, formerly of the Abilene Laboratory, has been appointed acting manager of geological research and has moved his headquarters to Richardson. **Morris Bock**, formerly in charge of Southwest Production Laboratory at Dallas, also has moved with his group to Richardson, as has **I. B. Hamilton**, head of the Geologist Service Section, formerly located in the Dallas office. Among other key men in the new research activity are **B. M. Gottlieb**, formerly of the Philadelphia office, who will be responsible for the liaison between operations and research in reservoir mechanics and production technology, and **Fred M. Mayes**, formerly of the Physical Research Laboratory at Newton Square, Penn., who will continue in charge of these research programs in well logging and geophysics, transferred from the Newton Square laboratory. **J. W. Jones** also has moved from Newton Square as a research engineer. Johnson has been with Sun since 1938, first working at the Geophysical Laboratory at Norwood, Penn. He was appointed acting director of production research and development in 1953.

•

William **R. Carlisle**, associate general counsel of **Standard Oil Company (New Jersey)**, has been appointed Jersey Standard's government relations counselor. He succeeds **Cecil Morgan** who recently became executive assistant to Eugene Holman, chairman of the board. Carlisle joined what is now Esso Research and Engineering Company, the central research affiliate of Jersey Standard, in 1930 as legal assistant to the president. He was made a counsel for Jersey Standard in 1942, and two years later became vice president in charge of patent and legal matters for the research company. He was appointed associate general counsel of Jersey Standard in 1947.

W. R. Carlisle

•

**Judson Laird**, in charge of transportation public relations for the Sun Oil Company, has been elected chairman of the Public Relations Committee of the American Merchant Marine Institute. Succeeding Frederic P. Sands of the Grace Line in the chairmanship, Laird is the first representative of a tanker-operating company to head the committee.

**International Petroleum Company, Limited** announces the election of **G. E. Wagoner** as a director of the company. Wagoner started with Humble Oil & Refining Company in 1930, later joining the Standard Oil Company of Louisiana where he was chief geophysicist. He moved to Carter Oil Company in 1937 and resigned as Western division manager in 1954 to accept the position of exploration advisor with International.

•

**Gulf Oil Corporation** recently appointed four coordinators to assist senior vice presidents of the corporation in carrying out their administrative functions. **R. A. Hunter** has been named coordinator, Marketing department, reporting directly to Senior Vice President **H. G. Meador**, Marketing. Hunter will work with him and the vice presidents of domestic marketing and foreign marketing in formulation and coordination of policies, plans and programs. **A. C. Rall** and **J. T. Tim, Jr.**, have been appointed coordinators on the staff of **W. L. Naylor**, senior vice president, financial. Rall and Tim will assist in formulation and coordination of policies, plans and programs in the international financial activities of the corporation and its subsidiaries and affiliates as they affect the comptroller and managers of the Tax, Credit and Budget departments. **Hollis D. Hedberg** has been named coordinator and appointed to the production coordination staff. He will report to **R. O. Rhoades**, senior vice president, production, and maintain close relationship with the company's exploration activities in both the Eastern and Western Hemispheres, as carried out by the Production department's several divisions. All four of the new coordinators are veterans of long experience, not only with Gulf, but in their respective fields.


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# DEATHS

**Charles O. McClintock**, 85, retired oil pioneer, died November 23 at Nowata, Okla. He was the son of the late H. H. McClintock who witnessed the Drake Well, drilled on a farm adjacent to the McClintock property near Titusville, Penn. McClintock moved to Tulsa in 1906 as superintendent of Laurel Oil and Gas Company and to Nowata in 1910 as a drilling contractor. He retired in 1920.

**James A. Brouk**, 65, died November 21 in Tulsa. An independent oil man, he retired in March, 1955.

**Grady H. Vaughn**, 65, head of the G. H. Vaughn Production and Dixie Drilling Companies, died recently in Dallas. His holdings extended into 14 states.

**Walter A. Harvey**, 65, former assistant purchasing agent for Skelly Oil Company died November 11. He worked for Skelly 18 years, resigning to become a manufacturer's representative. He retired two years ago.

**Russell C. Conkling**, 58, geologist and oil operator of Midland, Texas, died November 8 in Eureka Springs, Ark., while on vacation. He worked for a number of major oil companies in the U. S. and abroad before becoming a consultant and independent in 1935.

**Charles B. Peters, Jr.**, 44, president of the Norbla Oil Company, died in Tulsa, December 1. A Tulsan 34 years, he had headed the Norbla firm since 1933. His father, Charles B. Peters, Sr., was founder of the oil company.

**Frank A. Rehm**, retired vice president of Shell Oil Company, died recently in San Francisco. Prominent in the oil industry nearly 40 years, he began with Shell as a geologist at Ventura in 1916. In 1939 Rehm organized a new Personnel and Industrial Relations department for Shell and was appointed vice president in charge of that department in 1944. Since his retirement in 1953, he has been secretary-treasurer of the Pacific Oil Institute.

**Robert C. Bearden**, 58, widely known in the oil industry and executive vice president of Sinclair Pipe Line Company, died in Afton, Okla., November 3. He began his career in the executive department of the old Prairie Pipe Line Company, transferring to the field operations office in 1919. In 1951 he was elected vice president of Sinclair Pipe Line Company, and executive vice president and a member of the board in 1953.

**Frank A. Edson**, 75, retired consulting petroleum geologist widely known in the Mid-Continent area, died November 7 at Chillicothe, Ohio. He was a former member of the Oklahoma Geological Survey and professor of geology at the University of Oklahoma.

**Merle Thorpe**, journalist and writer and in recent years director of business development for Cities Service Company, died October 31.

**Paul Kasishke**, 57, president of the P-K Oil Company and a jobber for Skelly Oil Company, died in Amarillo, Texas, November 21. He was the brother of the late Albert G. Kasishke, founder of the Kasishke Rig Building Company.

**Hily W. Lee**, 72, died November 22 in Tulsa. He was president of the Lee Oil Company.

**Joseph Hall Feemster, Jr.**, 71, well-known mechanical engineer, died October 28. He retired two years ago after working for Worthington, Inc., 47 years.

**Francis L. Bishop**, 53, consulting geophysicist and independent oil producer of Tulsa, died October 26. With Geophysical Service, Inc., 15 years, he went to Tulsa from California in 1939 and became an independent in 1943.

**Blaine S. Smith**, retired president of Universal Atlas Cement Company, died at New Rochelle, N. Y., October 27. He had been with the cement company, a U. S. Steel Corporation subsidiary, 37 years, retiring in 1953. For a time after his retirement he continued with the company in a consulting capacity.

**Charles Willis Hughes**, 64, Louisiana oilman and manager of the Production division of Arkansas Fuel Oil Corporation, died in Shreveport December 8. In the oil business since 1919, Hughes joined a predecessor company of Arkansas Fuel Oil in 1919.

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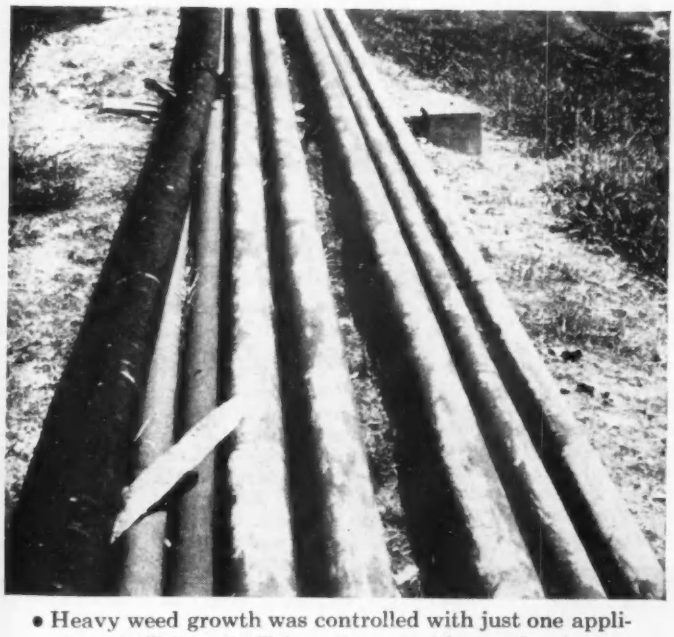

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# What's Happening

## AMONG INDUSTRY ASSOCIATIONS

### *AAPG Pacific Section Installs Officers*

**The newly-elected officers of the Pacific Section of the American Association of Petroleum Geologists are, from left to right, Mason L. Hill, chief geologist with Richfield Oil Corporation, president; Loyde H. Metzner, assistant chief geologist with Signal Oil & Gas Company, vice president; Thomas A. Baldwin, senior geologist with Monterey Oil Company, secretary; and Everett W. Pease, chief geologist with Sunray Mid-Continent Oil Company, treasurer. The men were installed at the annual meeting of the AAPG which was held recently in Los Angeles.**

### AIME Officers, Directors Elected for Coming Year

The board of directors of the American Institute of Mining and Metallurgical Engineers have declared Grover J. Holt president-elect of the Institute in 1956, to serve in 1957 as president. Lloyd E. Elkins and J. L. Gillson were elected vice presidents, and six additional directors were named, all to serve three-year terms.

Holt, general manager of the Ore-Mining department of the Cleveland-Cliffs Iron Company, has been active in the AIME many years. In 1950 he was chairman of the Minerals Beneficiation division.

Elkins, named vice president for a second term, is director of production research for Stanolind Oil and Gas Company. He has been with the company since 1934. In 1949 he was chairman of the Petroleum Branch of AIME. Gillson is geologist in the Development department of E. I. du Pont de Nemours & Company. He was chairman of the Industrial Minerals division of AIME in 1947 and had served a previous term as vice president in 1951-54.

Directors elected were Russell B. Caples, vice president in charge of metallurgical operations of the Anaconda Company and president of Anaconda Aluminum Company; Charles R. Dodson, assistant vice president of the First National City Bank of New York; Andrew Fletcher, president of St. Joseph Lead Company; Charles R. Kuzell, vice president in charge of Western activities for Phelps Dodge Corporation; Fred J. Meek, plant engineer for the Fairmont Plant of American Zinc Company; and Gail F. Moulton, staff geologist for Rockefeller Bros., Inc.

### *International Guests Attend Los Angeles Meeting*

**The Los Angeles Chapter of Nomads hosted the following foreign guests at a recent meeting: (left to right, standing) C. M. White, Iraq Petroleum Company, Basra; C. L. Buckingham, National Petroleum Company of Egypt; William P. Ries, Santa Fe Drilling Company, Venezuela; C. H. Strickland, Iraq Petroleum Company, Qatar; Kenneth Tate, Colombian Petroleum Company; M. J. Abernathy, Iraq Petroleum, Iraq; and Robert Peters, Creole Petroleum Company, Venezuela. Seated are Mart Hulshizer, Drilling & Exploration Company, Dhofar; E. J. Scroggins, Shell Oil Company, Venezuela; Pio Castagnoli Cia. Nacional de Sondagens, Rio de Janeiro; R. W. Anderson, California Division of Highways, guest speaker; W. C. Kirby, Socony Mobil Oil Company, Venezuela; and C. J. Taylor, Baker Oil Tools, Inc., Calgary.**

### Instrument Short Course Scheduled January 26-27

The fifth annual Instrument Short Course will be held January 26-27 at Los Angeles Harbor Junior College in Wilmington, Calif. Co-sponsored by the Southern California Meter Association and the Los Angeles Harbor Junior College, the course, covering all phases of instrumentation, serves as a refresher course for engineers on basic instrument principles, as well as an opportunity to keep pace with advancing technology in the field of instrumentation and automation.

Along with a technical papers section, there will be a practical methods section designed to train technicians in maintenance, calibration and application of instruments and control devices. A third phase of the short course will be an exhibit put on by instrument and control manufacturers featuring late model equipment.

### Pampe Is New President Of Illinois Geological Group

Carl F. Pampe, Pure Oil Company, heads the new slate of officers elected by the Illinois Geological Society for 1956. Max C. Firebaugh, with Collins Brothers Oil Company, was elected vice president, and Lester L. Whiting, with Illinois Geological Survey, was elected secretary-treasurer.

### Rocky Mountain Geologists Schedule Denver Convention

Tectonic framework of the Rocky Mountains will be the theme of the sixth annual convention of the Rocky Mountain Section of American Association of Petroleum Geologists to be held in Denver February 27-29. More than 2500 registrants are expected.

Concentrating on the study of earth movements which created the Rockies and the timetable of changes which took place during geologic history, papers to be presented also will include discussions of the effect of these formative forces on the accumulation of oil and on the accumulation of uranium deposits.

### Three AAODC Sections Announce 1956 Officers

Baker Littlefield, Power Rig Drilling Company, has been elected chairman of the South Louisiana Chapter of American Association of Oilwell Drilling Contractors. R. V. Pierce, Wheless Drilling Company, was named vice chairman, and J. B. Hamilton, with W. C. Fatjo Drilling Company, secretary-treasurer.

In Denver, Will I. Lewis, Jr., Will I. Lewis Drilling Company, has been named chairman; A. J. Courson, Love-Miller Drilling Company, Inc., vice chairman; and Calvin York, Carmack Drilling Company, secretary-treasurer.

Don Slape, with Don Slape Drilling Company of Olney, Ill., heads the Tri-State Chapter as chairman. Hunter Eakle is vice chairman of Tri-State, and Charles Pardee, Jr., secretary-treasurer. Eakle is with Eakle & Holder Drilling Company.

## Hamon Succeeds Spencer As API Board Chairman

J. L. (Jake) Hamon, independent oil producer from Dallas, was named chairman of the board of the American Petroleum Institute at the 35th annual API meeting in San Francisco. He succeeds P. S. Spencer, president of Sinclair Oil Corporation.

J. L. Hamon

Frank M. Porter, president of Fain-Porter Drilling Company, Oklahoma City, was reelected API president, and Frank O. Prior, president of Standard Oil Company (Indiana), Chicago, was elected vice president for transportation. He succeeds Charles S. Jones of Richfield Oil Corporation, Los Angeles.

During his 30-year career in the oil industry, Hamon has served as director and Executive Committee member of the Independent Petroleum Association, as API vice president for production and as chairman of the Division of Production's General Committee, and as president of the Texas Mid-Continent Oil and Gas Association, the National Stripper Well Association and Independent Oil Producers Equity Association. He received the distinguished service award of the Texas Mid-Continent Oil and Gas Association in 1950. During World War II, he was a member of the Petroleum Industry War Council.

Other API officers reelected were A. W. Thompson, vice president for production; E. B. McConnell, vice president for refining; J. G. Jordan, vice president for marketing; B. B. Jennings, treasurer; and Lacey Walker, secretary.

## Robertson Succeeds Bass As Texas Oil & Gas Head

French M. Robertson, independent oil producer, prison board member and former defense chief, was elected president of the Texas Mid-Continent Oil & Gas Association at the final session of the Association's recent annual meeting. He succeeds Harry W. Bass, Dallas independent producer and drilling contractor, who served two terms as head of the state's oldest and largest organization of oil and gas producers.

F. M. Robertson

Robertson is a former regional vice president of the Texas Mid-Continent. He is serving his ninth year as a member of the board of The Texas Prison System and is past southwest regional administrator for the Federal Civil Defense Administration.

In 1937 he became actively engaged in the oil business, following a period of private law practice. His first post-war well was a producer in the Sharon Ridge Pool of Scurry County. He has since drilled over 100 wells in the field and has participated in or drilled over 250 wells in the West Texas area in the last ten years.


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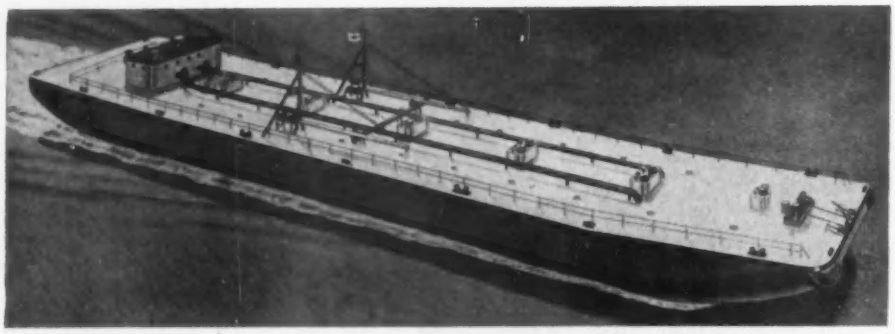
# Companies in the News



## World's Largest Oil Tow Barge Launched

**A coastwise oil-carrying tow barge, believed to be the largest in the world, has been launched by Pacific Coast Engineering Company for Tide Water Associated Oil Company. The vessel has been fitted with a specially designed bow and with skegs to reduce yawing in rough coastal waters. Christened the AMORCO, the barge is 50 feet wide, 290 feet long, has a draft of 18 feet 7 inches and a flush deck. Its 14 separate cargo tanks are able to carry 48,100 barrels of oil.**

**GULF OIL CORPORATION** will acquire the Warren Petroleum Corporation of Tulsa, according to a joint announcement by William K. Whiteford, president of Gulf, and William K. Warren, founder and chairman of the board of Warren Petroleum. Basis of the transaction is an exchange of Warren stock for stock of Gulf Oil. The transfer is expected to become effective this month. The Warren company was organized in Tulsa in 1922 and is now considered the largest company in the country engaged in production and distribution of liquefied petroleum gas products. Warren's total assets at the close of the last fiscal year, June 30, were $163.9 million. No change in management or personnel of the Warren company will be made, it was announced.

•

**DELHI-TAYLOR OIL CORPORATION** recently opened a district production and drilling office in the Kennedy building, Tulsa. At present, E. W. Adams, district superintendent, has a staff chiefly of engineers and materials men in the new office.

**MEADOWS & WALKER DRILLING COMPANY** recently was formed from the Meadows-Townsend Drilling Company when **Hiram I. Walker,** formerly with Brewster-Bartle Drilling Company, purchased the interest of George W. Townsend. The firm was reorganized under the new Texas Business Corporation Act, the charter was amended and the firm name changed. Walker has been elected vice president, secretary-treasurer and director.

•

**SHELL OIL COMPANY** will be the major tenant of a new ten-story office building to be built in Tulsa. Completion date of the reinforced concrete structure, to be called the Shell Building, is expected about June, 1957, at a cost of over $2 million. The company's Mid-Continent exploration and production activities will be headquartered in the building, with some 400 employes occupying the top six floors. A Shell employment office will be located in the lobby, and Shell Pipe Line Corporation communication offices will be on the third floor.

**CITIES SERVICE OIL COMPANY** has consolidated the Bismarck, N. D., and the Billings, Mont., land and geological departments at Billings. **Rex Tarr,** district landman at Bismarck, has been transferred to Fort Worth, Texas, and **Robert Cole,** district geologist, is now at Calgary, Alberta, Canada. **Don Huber,** geologist, and **Cyril Spackman,** draftsman at Bismarck, are now at Billings. **Bob L. Thompson,** geological scout, remained at Bismarck. In the Cities Service Mid-Continent division, the land-geological division will be expanded to include northwestern operations. **Murray J. Wells** is to be manager of the enlarged division and will transfer from Casper, Wyo., to Bartlesville, Okla., headquarters. **William M. Schulz** will be division geologist and **Mark F. Payton,** division landman.

•

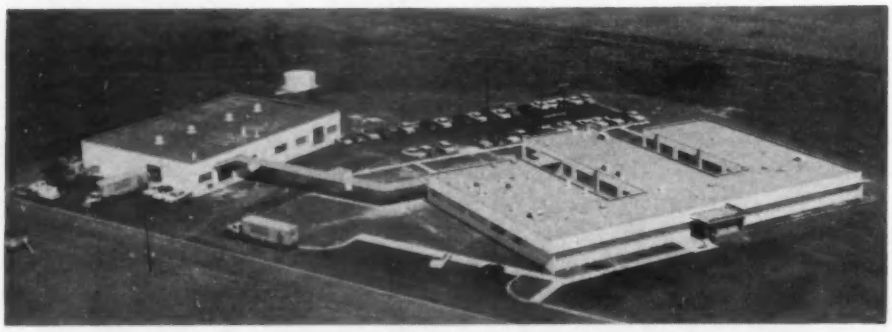
**TEKOIL CORPORATION's** agreement to purchase all oil and gas properties of Kio Oil and Development Company has been announced by W. H. Davison, president of Tekoil, and Arthur J. Feicht, Sr., president of Kio and chairman of its board. Involved in the sale at a price in excess of $1 million are operating and non-operating oil and gas properties in Illinois, Indiana, Kentucky and Texas.

•

**CRESTMONT OIL COMPANY** has announced the acquisition of total assets of C. K. M. Oil Company. The new property, consisting of 65 acres on the south edge of the Fruitvale field in Kern County, California, will increase Crestmont's gross daily production from the present 1250 barrels to more than 1500 barrels per day.

•

**SKILES OIL CORPORATION** has opened a division office in Greenville, Ky., to handle increased company activity in the area. The company, with a number of drilling associates, is drilling more than 40 wells in the state. **M. G. Cook** has been appointed division manager and **William S. Wood,** chief geologist. Cook has been with the Skiles organization since the end of World War II; Wood joined Skiles geological staff in 1954.



## Sun Oil Completes New Laboratory

**Sun Oil Company's new production research and development laboratory at Richardson, Texas, near Dallas, was dedicated officially December 7. Research programs in geology and geophysics, reservoir mechanics and production technology will be conducted at the laboratory, which consists of two buildings. The laboratory proper covers approximately 20,000 square feet. The service building, connected to the main laboratory by a covered walkway, is rectangular in shape with 10,000 square feet of floor space.**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**The complete editorial index covering all issues of WORLD OIL published during 1955 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.**

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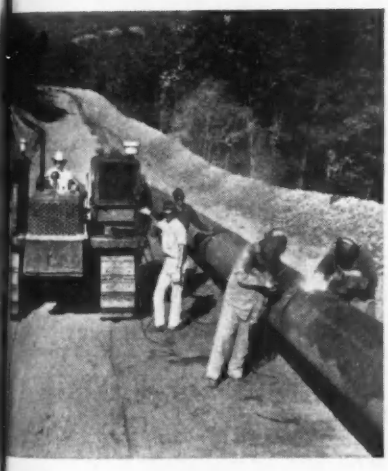

**lds 55 mi. gas line**—two 40-volt weld- on TD-14 provide power for stringing e, Seneca, West Virginia, to Woodstock, rginia. Pipeline Construction & Drilling mpany, Camp Hill, Pennsylvania, weld 500 feet daily with this rig.

**Clears 50-ft. right-of-way**—Clearing on same job described left is being done by TD-24 shown, plus 2 TD-18's and 2 TD-9's. Despite rough, rocky, mountainous terrain and 4500-ft. altitude, fleet clears an average of ½ mile per day.

**"Best for backfilling"** says R. M. Paylor, Pipeline Construction & Drilling Co. foreman, of International Drott TD-9. "It has highest reach and best balance of any equal-size loader. Hydro-spring sure saves wear in rough rock work."


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# What's Happening

## AMONG SERVICE AND SUPPLY MEN

Hal Bentson

John C. McCauley

Rodney S. Durkee

Troy D. Williams

D. L. Witzel

James E. Saunders

Mathew L. Freeman

Don B. Sandford

Clint M. Roberts

Thomas P. Harrison

George L. Warren

Louis E. Dondero

**H. C. Smith Oil Tool Company** has announced the appointment of **Hal Bentson** as chief engineer-sales. With Security Engineering Company 17 years, he has a background of 20 years experience working with drilling and production tools in research, development and design. With H. S. Smith, Bentson will travel throughout the U. S. and Canada.

**John C. McCauley,** now on the sales engineering staff of **Hammond Iron Works,** has been in the metal fabricating industry for the past 11 years. With headquarters in New York City, his services will be available to all petrochemical and processing industries.

**Rodney S. Durkee,** chairman of the board of Lane-Wells Company, has been elected president of the California Manufacturers Association. He will hold the post for the 1955-56 fiscal year. Durkee also is a director and a member of the executive committee of Dresser Industries, Inc., owners of Lane-Wells. He was president of the Petroleum Equipment Suppliers Association for 1954 and served two terms as a director of the American Petroleum Institute.

**Troy D. Williams,** formerly office manager for the northern division for **Otis Pressure Control, Inc.,** has been appointed to the firm's sales department. He will continue to work out of the Oklahoma City office. Williams began with Otis in Oklahoma City in 1953. He was later promoted and assigned to the company's New Iberia, La., division until his transfer back to Oklahoma City as office manager. Prior to joining Otis he was with the Wilder Company.

**Axelson Manufacturing Company,** division of U. S. Industries, Inc., has announced the appointment of **D. L. Witzel** as area manager, Southern California division. With Axelson since 1935, he has worked in the Torrance, Taft, Bakersfield and Long Beach districts. **James E. Saunders** has joined the company as a market research analyst, moving from Union Oil Company of California where he was in the Market Research department. In Axelson's Rocky Mountain-Canadian area, **D. D. Blodgett** has been appointed sales manager for the company. He will make his headquarters in Denver.

**McEvoy Company** of Houston announces the appointment of **Mathew L. Freeman** as new controls division engineer, to supervise development of systems and equipment for automatic controls. He formerly was with Atlantic Refining Company as a laboratory design engineer, designing and fabricating all types of electrical and pneumatic controls.

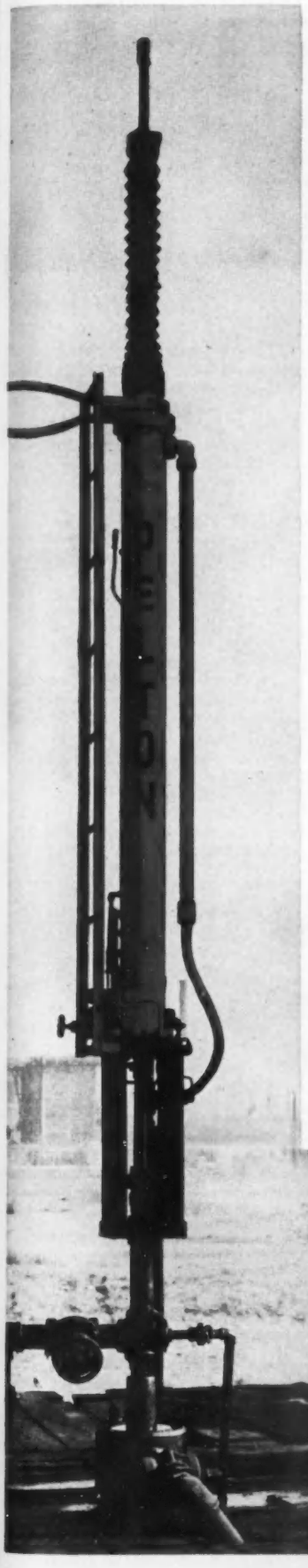
**Don B. Sandford,** recently appointed manufacturer's sales representative, Industrial Power division, for **International Harvester Company,** is a 21-year employe of the firm. His entire service has been in engineering design and sales engineering, and, for the past ten years, he has been active in oil field preparations.

**Halliburton Oil Well Cementing Company** has named **Clint M. Roberts** assistant treasurer and general credit manager. A veteran with Halliburton, he began his career as a cementing truck driver in 1928. Moving to headquarters at Duncan, Okla., in 1932, he has since headed credit operations there.

**Willis Oil Tool Company** announces the appointment of **Thomas P. Harrison** as district manager in New Orleans. He has had a number of years' experience in various phases of the industry, and will be in charge of sales and services in the New Orleans area. In Houston, Willis has named **George L. Warren,** a veteran in the wellhead business, sales and service representative. He replaces **R. S. Amend** who was transferred to the Willis plant at Long Beach, Calif.

**Louis E. Dondero** is now manager of the Cleveland Rock Drill plant of the Le Roi Division, **Westinghouse Air Brake Company.** He succeeds Russell R. Morgan, retired. Dondero, who joined Le Roi in 1946 as assistant service manager, was most recently manager of Le Roi's service department. Prior to that, he had been assistant production manager, production manager and assistant works manager.

**U. S. Steel's** Oil Well Supply Division has announced appointment of five field representatives. They are **Evan P. Kelly, Ray J. Bosley, Harman Holcomb, Jr., Henry W. Harless** and **Elton E. McGee.** Kelly, who is being transferred from Denver City, Texas, to Andrews, Texas, was employed by the division in 1950 at Odessa, Texas. In 1952 he was appointed field representative and transferred to Denver City, where he was located prior to his present transfer. Bosley, appointed field representative at Andrews, was employed by Oilwell in 1952 at Monahans, Texas; Holcomb, named field representative at Denver City, was employed by Oilwell at Snyder, Texas, in 1952, transferring to Denver City the following year. Harless, who was appointed field representative at Odessa, joined the division in 1954, and McGee, named field representative at Snyder, was employed by Oilwell in 1953.



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### Hydraulic Pumping Jack

### 13,000 Lb. Polish Rod Rating

Proving highly successful in medium to low production wells is this new Pelton S-6 Six Foot Stroke Hydraulic Pumping Jack. Compare the features of this jack and test it on your own wells. You will quickly discover in the Pelton S-6 a new, less expensive pumping method.

1. 6 Ft. stroke length up to 4.6 SPM.
2. 13,000 lb. maximum polished rod loading.
3. The polished rod speed can be adjusted for a slow upstroke and fast downstroke. Pump spacing easily done by adjusting polish rod clamp at top.
4. ***Power oil used to actuate the unit is completely isolated from the oil being produced and from contaminants, water, etc., which would ordinarily dilute the power oil.***
5. The SPM can be slowed down to allow efficient filling of the bottom hole pump barrel allowing the well to produce continuously. The slow SPM and continuous operation gives increased production, eliminates pump sanding and gas lock.
6. Mounts directly in 3 inch well head nipple.
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8. Large reserve oil tank with inspection plate and gauge. Low operating pressures (500 psi).
9. No gear box or vibration due to swinging weights.
10. Amazingly simple to operate and trouble free. Small and compact for easy installation and operation, yet rugged in construction.
11. Lower in price than comparable beam units.

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**Specifications S-6**

| | |
|---|---|
| Maximum Polished Rod Load | 13,000 lb. |
| Maximum Load Range | 13,000 lb. |
| Maximum Counterbalance | 0 |
| Nominal Stroke Length | 72" |
| Maximum Operating Speed (SPM) | 4.6 |

*Send today for illustrated catalog and prices.*

Herb Klepfer

Gordon Morrison

R. C. Brenner

R. O. Linville

R. A. Harmon

Miles B. Sanger

**Baash-Ross Tool Company Division** of Joy Manufacturing Company announces the appointment of **Herb Klepfer** as export sales manager for the company. Formerly with Shell Chemical Company and Sunray Oil Company, Klepfer was sales representative for Baash-Ross in the San Joaquin Valley area of California before this recent appointment. Other promotions announced by the company include **Gordon Morrison**, named sales manager in the Canadian area, and **R. C. Brenner**, named sales manager in the Rocky Mountain area. After 18 years' drilling experience, Morrison served in a supervisory capacity with Commonwealth Drilling Company Ltd. and with Pacific Petroleum Ltd. before joining Baash-Ross as sales representative. Brenner formerly was with Monarch Logging Company as party chief. He will work out of Denver.

**Welex Jet Services, Inc.** recently named **R. O. Linville** sales engineer at the Pampa, Texas, district office. A two-year veteran with the company, Linville worked as a rigger and shooter before going into sales work.

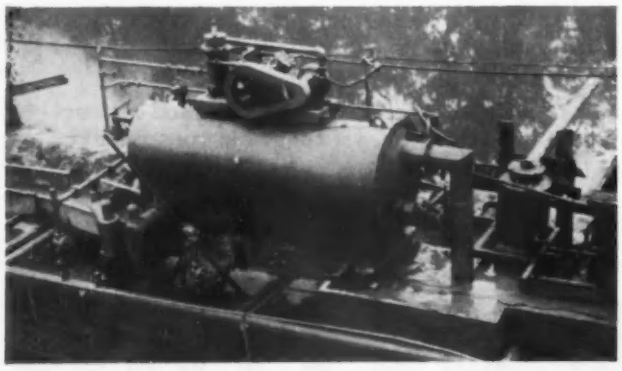
**Twin Disc Clutch Company** has announced the appointment of **R. A. Harmon** as district sales supervisor. He will be responsible for coordinating geographical marketing, and general supervision of the activities of Detroit, Los Angeles, Newark, Cleveland, New Orleans, Rockford and Racine branch sales offices. Harmon has been in sales engineering work since joining Twin Disc more than eight years ago.

**Miles B. Sanger** has been appointed Huntington, W. V., district manager of **Enterprise Engine & Machinery Company**, subsidiary of General Metals Corporation. He has been with Superior Engine division of the National Supply Company for the past 14 years.

**Rector Well Equipment Company, Inc.** recently named **J. B. Fanning** sales representative at Farmington, N. M. Widely experienced in oil field sales and service work, he previously has been with Schlumberger, Seismograph Company, The Texas Company, Noble Drilling Company and Hughes Tool Company.

**Dorr-Oliver Incorporated** announces the appointment of **Harvey J. Goetz** as manager of Dorr-Oliver (India) Limited, one of its seven associated companies abroad. Goetz will initiate arrangements to manufacture Dorr-Oliver equipment locally in India. Joining the company in 1938 as an office boy, he later served in the New York office, as development engineer in the research laboratories, and in the Central Sanitary division in Chicago. In 1953 he was assigned to the Stamford, Conn., office where he has been responsible for all sanitary engineering projects handled by International Sales.

**Ralph G. Griffin**, appointed manager of **Worthington Corporation's** Cincinnati district office, succeeds **Earle W. Vinnedge** who has been named special representative of the Cincinnati office concentrating on larger negotiations. Vinnedge, with Worthington 40 years, has been Cincinnati office manager 28 years. Griffin joined the company in 1930 as a student trainee, serving later in St. Louis and Buffalo. In 1953 he was appointed assistant manager of the Cincinnati district office.

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- Reduces mud costs
- Saves lost rig time
- Reduces high funnel mud viscosities

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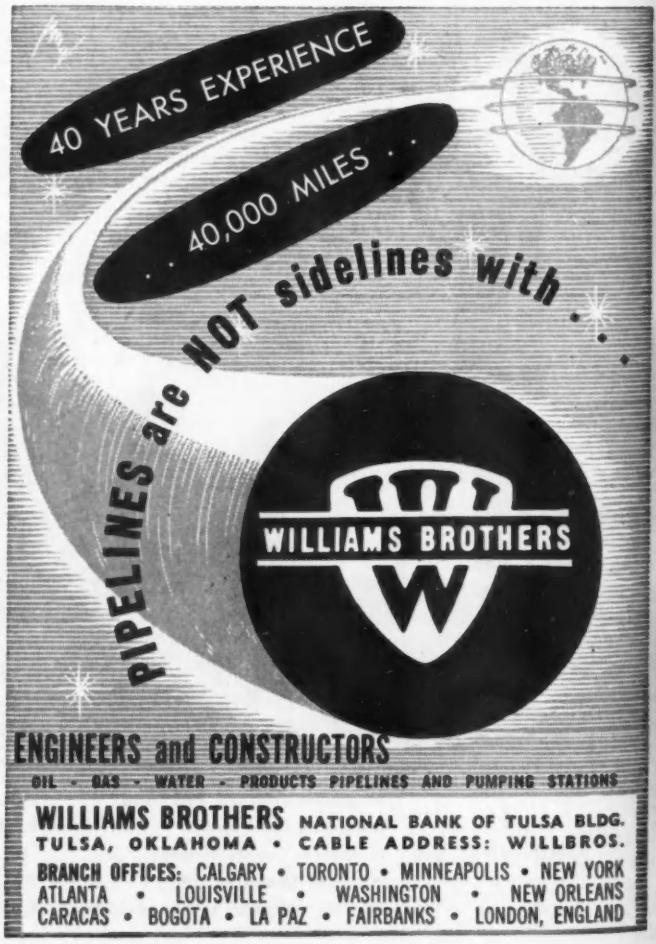
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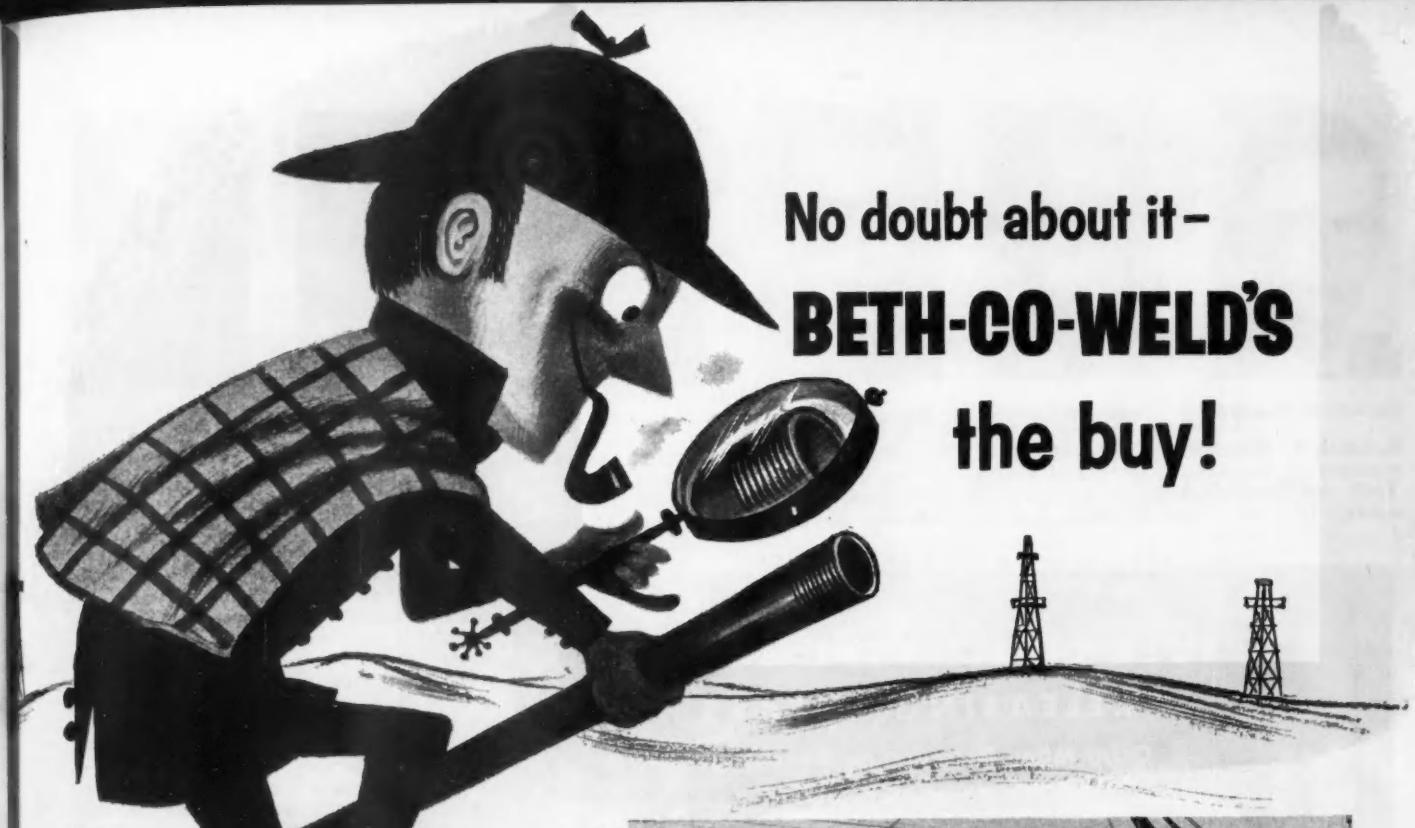
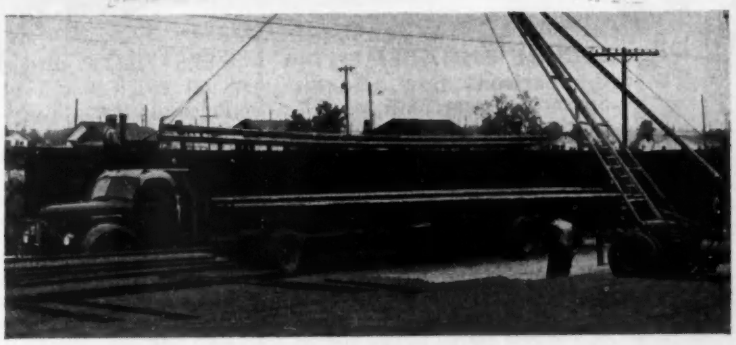
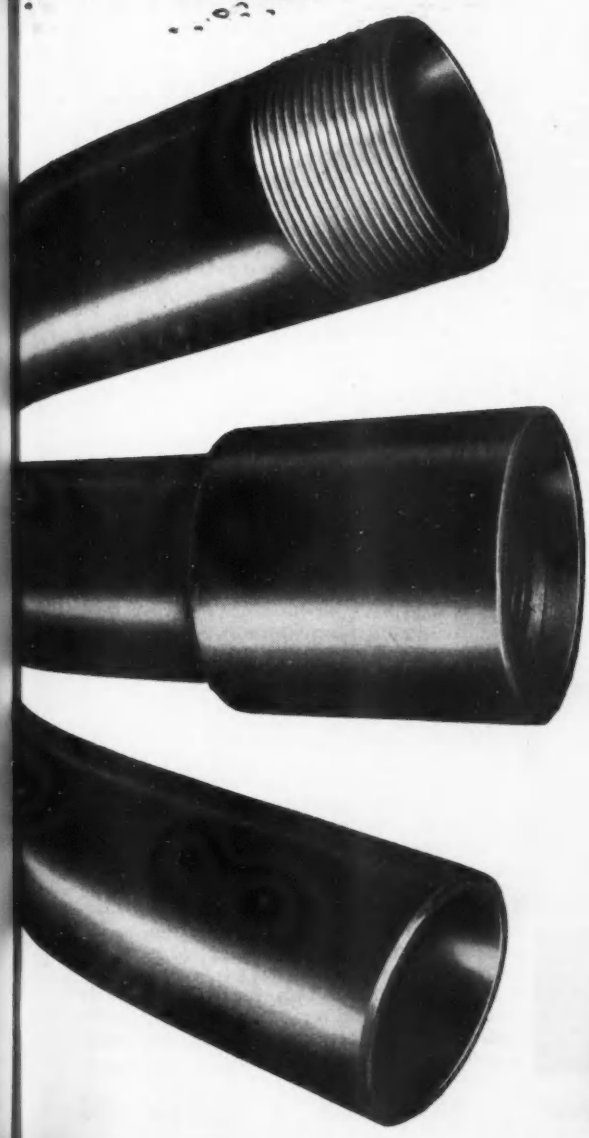


# No doubt about it–
# BETH-CO-WELD'S the buy!





Whenever you need line pipe for jobs around the lease or rig, you can count on good, dependable service from Beth-Co-Weld steel pipe.

Beth-Co-Weld is quality pipe through and through. In fact, Beth-Co-Weld is backed by years of customer approval, being one of the first fully accepted types of continuous-weld line pipe in the oil fields. It's ideal pipe for gathering systems, gas-distribution systems, service lines on the drilling rig, and maintenance piping.

Beth-Co-Weld can be furnished in accordance with the requirements of ASTM-A-120 and A-53, API 5L and other equivalent specifications. It is sold on a competitive basis. It can be obtained coated, or uncoated for field wrapping. In addition, it can be wrapped at the mill. You can get prompt delivery, too, regardless of quantity.

Your nearest Bethlehem Supply store has a large stock of Beth-Co-Weld on hand, ready for loading at a moment's notice. They'll welcome your inquiry.

**Beth-Co-Weld comes in sizes from ½ in. nominal to 4½ in. OD in both black and galvanized in standard weight, and in sizes ½ in. through 3 in. nominal in extra-strong weights. Supplied in weights lighter than standard in sizes 3½ in. OD and 4½ in. OD. Available in single mill lengths, also in sizes 1½ in. through 4½ in. OD in double mill lengths up to 50 ft, and can be furnished threaded and coupled, plain end beveled for welding, or plain end square cut grooved for ring joint coupling.**

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BETHLEHEM STEEL

Kenneth A. Woodard

Thomas W. Landry

Charles E. Nelson

Charles W. Tittle

Earl J. Davis

Harold R. Briscoe

**Kenneth A. Woodard** has been appointed manager of the Houston district of **Union Tank and Supply Company.** Prior to assuming his new duties, Woodard was in the Engineering department and City Sales department five years. Newly-appointed city salesman in Houston is **Thomas W. Landry,** who was an industrial engineer for the Cameron Iron Works before joining Union Tank.

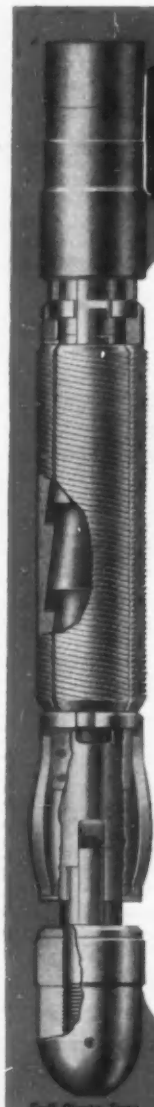
**Waukesha Motor Company** announces the election of **Charles E. Nelson** as secretary and treasurer of the company. He had been vice president in charge of production. Nelson's earliest activities with the company were with the Financial department which led to his appointment in 1933 as secretary and treasurer of the Fageol Truck and Motor Coach Company, at that time a Waukesha subsidiary. Returning to the parent company in 1934, he became factory production manager, and in 1936 was made director of purchases and production planning. In 1949 he was appointed to the vice presidency.

**Tracerlab, Inc.,** recently appointed **Dr. Charles W. Tittle** manager of the Western division. He formerly was head of the Nuclear Physics Section, Gulf Research and Development Corporation.

**Earl J. Davis** and **Harold R. Briscoe,** formerly area managers in **Dowell Incorporated's** Illinois and Texas Gulf Coast districts, are now located at the company's general offices in Tulsa. Davis will be assistant to the general manager and Briscoe will be a member of the Personnel department. Davis joined Dowell in 1948 as a service engineer at Great Bend, Kansas. In 1953 he was appointed Illinois district area manager. Briscoe joined Dowell in 1951 as a junior service engineer. He served as service engineer, station manager and sales engineer at various locations before becoming district area manager at Houston in 1954. Replacing Davis will be **James R. Paul** who transferred from Wichita, Kansas, where he has been district engineer since 1952. To replace Paul in the Kansas office will be **S. R. West,** former petroleum engineer for Dowell at Great Bend.

**Bill Bayless,** newly-appointed sales and service representative for **Sivalls Tanks, Inc.,** will make his headquarters in Odessa, with his territory centering on Snyder, Lubbock, Big Spring and Lamesa and north through Hale, Floyd and Motley counties. Prior to joining the company last year, Bayless was with Chapman and McFarlin Producing Company.

**Aeroquip Corporation** announces several organizational changes: **Wayne G. English,** who came to the company from the Ford Detroit Truck Plant, has been appointed treasurer of the firm; **Kent R. Manning,** formerly the company's manufacturing manager, has been named general manager of the Jackson division; **George Lagassa,** former production control manager, has been appointed plant manager of Elbeeco, Inc.; and **Dan Rupple,** formerly assistant control manager of the Jackson division, has been promoted to production control manager.


FULL CIRCLE TYPE BOWEN RELEASING SPEARS

Offer Many Outstanding Advantages

**SECURE ENGAGEMENT**— Comparisons show that this Spear has from 35% to 45% more useful slip engagement area than any other spear on the market today! There is no loss of engagement regardless of the degree of the upward pull and regardless of the intensity of the jarring blows. On numerous actual jobs, in conjunction with hydraulic pulling tools and jars, pipe has been pulled and jarred in two below the Full Circle Type Bowen Releasing Spear with no distortion at the point of engagement.

**POSITIVE RELEASE**— Full Circle Type Bowen Releasing Spears provide means for hanging and supporting the Full Circle Slips in their uppermost position relative to the spear body. Full Circle Spears can be engaged with and released from a fish indefinitely without being withdrawn from the hole. The releasing mechanism is unaffected by excessive pulling strains, terrific jarring blows, and adverse well conditions.

**VERSATILITY and SAFETY** — All Full Circle Type Bowen Releasing Spears can be equipped to pack off the fish simply by removing the Safety Ring and by installing in its place a Safety Ring Pack-off.

All Full Circle Type Bowen Releasing Spears for Casing are engineered to provide greater tensile strengths than the tensile strengths of the pipe sizes that they engage.

The Full Circle Slips encompass so much of the inner area of the fish that it is virtually impossible for any junk to fall alongside and foul the mechanism of the Spear. The Full Circle Slips are designed to collapse below the outside diameter of the Safety Ring or the Safety Ring Pack-off. This feature insures the Spear ability to release from any fish that it has penetrated.

*Available in tubing and drill pipe sizes as well as in casing sizes.*

Write for descriptive literature

**ECONOMY** — Because Full Circle Spears do not distort the fish, there is no movement under strain of the spear within the fish and the Full Circle Slips can be subjected to great pulling and jarring strains with no wear whatever. Pipe and liners salvaged by Full Circle Spears are more usable because they are neither split nor distorted. Another time-saving feature is the fact that slips can be changed without removing the Nut from the Body.

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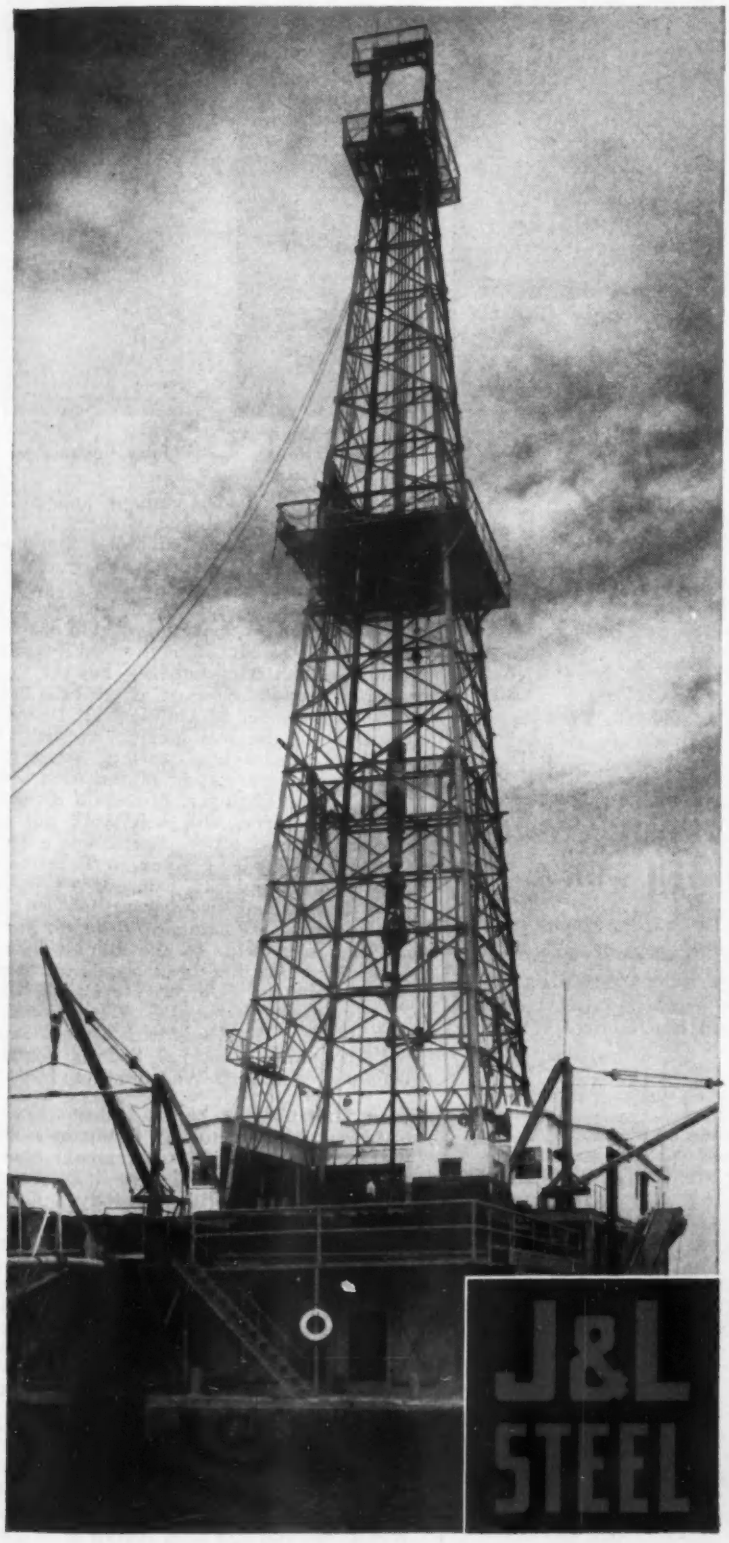
# WORLD'S DEEPEST OIL WELL!




Richardson & Bass Drilling Rig No. 25 at well known as Richardson & Bass (Louisiana Account)—John W. Mecom —Freeport Sulphur Company—Humble-Louisiana Land & Exploration—State Lease 2414, No. 1-L. Rig and boilers are mounted on two huge barges sunk to bottom of marsh to provide firm foundation for operations.

## Record depth of over four miles attained in Richardson & Bass Louisiana Well using J&L Drill Pipe and J&L Wire Rope exclusively

Wednesday, November 9, 1955, marked another milestone in the spectacular history of the oil industry. On that day, Richardson & Bass and their associates in this enterprise, John W. Mecom and Freeport Sulphur Company, broke the world's record for deep drilling in their well in Plaquemines Parish, Louisiana, 35 miles southeast of New Orleans.

This well, now more than four miles deep, has penetrated the earth to depths never before explored. Pressures are being encountered to which drill pipe never before has been subjected.

In discussing this new world's record well, J. E. (Ed) Hill, General Manager of Richardson & Bass Drilling and Producing Interests, said: "This well has been drilled from the surface to its total depth without a single pipe failure, a tribute both to the skill of the drilling crews, and to the quality of the pipe used."

Every foot of the drill pipe in the well is J&L Drill Pipe. To a depth of 13,655 feet, J&L Blue Ribbon Drill Pipe was used. From that point to the bottom, the string was replaced with J&L Blue Ribbon Vanadium Drill Pipe. Every foot of the wire rope which supports the entire four mile string of drill pipe is J&L Permaset Wire Rope. Hundreds of tons of J&L Casing have been set in the well, with additional hundreds of tons standing by for use when the well is completed.

To provide the high strengths needed in oil country tubular products for today's deep well drilling, J&L developed and has in operation extensive new finishing facilities—facilities which are already being expanded to keep pace with the oil industry's growing needs.

## Interesting facts about world's deepest well

**(As of November 28, 1955)**

Total depth 22,209 ft., nearly 4¼ miles, equal to height of 15 Empire State Buildings . . . previous record depth 21,482 ft. . . . drilling began February 26, 1955 . . . total drilling time 205 days . . . total testing time 71 days . . . total elapsed time 276 days . . . bottom hole pressure 20,650 lbs. per sq. inch . . . bottom hole temperature 350° F. . . . time required to pull entire string of drill pipe to surface, replace bit and reset pipe is about 11 hours . . . stretch in drill pipe at extreme depth is about 20 feet . . . total cost of well estimated at between $1¾ and $2 million.

Jones & Laughlin
STEEL CORPORATION — *Pittsburgh*

# *Portable*

# AUTOMATIC GAS LOGGER

## DETECTS
## GAS HYDROCARBONS
IN
## MUD-CORES-CUTTINGS

PRICE—
COMPLETE
LOGGER
ONLY,

**$985.00**

**Eliminates expensive logging services. Any well sitter can now log a well with this simple instrument.**

**AUTOMATIC**—Nothing to do but observe the meter as drilling proceeds. It enables driller to check all drilling breaks.

**SIMPLE**—Any layman, geologist, driller or engineer can operate this simple instrument. One meter and one control are used. Simply plug it into a light socket.

**CONTINUOUS**—Tests all the mud coming out of the well from every foot drilled.

**SENSITIVE**—Detects gas in the mud that cannot be detected by weight change or smell. Gases in cores and cuttings are detected, which are not detectable by smell or taste. Extremely sensitive.

**POSITIVE**—Instrument operates from rig lighting system and may be tested at any time by a simple test for accuracy.

**PORTABLE**—Equipment is self-contained in steel housing with door. Handles provided on housing for easy handling. Housing size is 12" x 14" x 27". May be carried in automobile trunk.

**CORES & CUTTINGS**—A sample housing is provided for a very sensitive test of cores and cuttings.

**USES**—Determines when to core, drill stem test and DEPTHS FOR SIDE WALL CORES. A 24-hr test for gas in the mud return. Comes complete with mud trap and instructions for operation. Price $985.00, F.O.B., Houston, Texas. Pat. 2,581,083 and 2,636,569.

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**2200 WEST ALABAMA STREET • HOUSTON, TEXAS**

Jim Edwards

Glen Horrie

Jack W. Holtz

Jules Haltenberger

**McCullough Tool Company** announces two major organizational changes in the Pacific and Mountain divisions: **Jim Edwards,** promoted to sales manager of the Mountain division, has established new division sales headquarters in Denver; and **Glen Horrie** has been transferred to Bakersfield, Calif., as McCullough's San Joaquin Valley district sales manager. For the past year Edwards has served as geologist and sales engineer for McCullough in Denver. Prior to this he was logging engineer at the Los Angeles headquarters, doing research on interpretation of radiation well logs. **Newton Ottinger,** Mountain division logging engineer, also will work out of the new Denver office. Horrie was a McCullough sales engineer in Bakersfield prior to becoming sales manager at Casper, Wyo. he had had several years' service experience with the company prior to entering the sales field. In the Illinois Basin, **Jack W. Holtz** has been appointed sales engineer at the company's Carmi, Ill., service branch location. Before joining McCullough, Holtz was with Oilwell Supply Company, General Oilfield Supply Company and Bird Well Surveys, Inc.

**Jules Haltenberger,** recent addition to the **Cardwell Manufacturing Company's** Export division, will visit government representatives and other Cardwell customers throughout the world. Formerly a Cardwell dealer in Hungary, he also has represented Caterpillar Tractor Company and other manufacturers of heavy equipment in Europe, was chief engineer and technical director of Ford Motor Company in Budapest and served as head of the Engineering department of the Colgate Palmolive Company in Buenos Aires. He has been in the petroleum industry since 1936.

**R. J. Rice of The International Nickel Company, Inc.,** has been appointed to the staff of the University of Texas M. D. Anderson Hospital and Tumor Institute as a consultant in analysis of trace elements. He also has been named a member of the Industrial Advisory Team of the Houston Chamber of Commerce. Rice is in charge of the Texas Technical Field section of International Nickel's Development and Research division. His headquarters are in Houston.

Harold P. Gustavson

Robert E. Hunter

Peter Ster, Jr.

Arthur C. Edwards

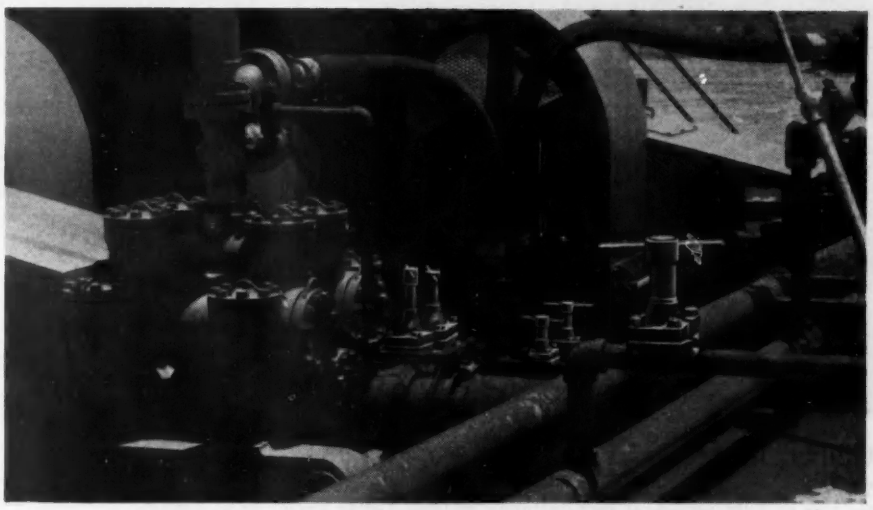
**General Motors** Electro-Motive Division announces the appointment of **Harold P. Gustavson** as petroleum equipment sales manager, in charge of sales for the division's recently announced diesel-electric power units for oil well drilling. He formerly was in locomotive sales as district sales manager of the firm's New York region. The appointment of **Arthur M. Hazell, Jr.**, as sales representative for petroleum equipment with offices in Houston, and the appointment of **R. H. Beight** as technical engineer, with headquarters in Fort Worth, also have been announced. In the Detroit Diesel Engine Division, **Robert E. Hunter** has been made general sales manager. First joining General Motors in 1937 as business management manager at the Pontiac Motor Division, Hunter has been director of sales of General Motors Diesel Limited of Canada from 1949 until his recent appointment.

**Cummins Engine Company, Inc.,** has appointed **Peter Ster, Jr.**, regional manager for eastern Canada with headquarters at Toronto, Ontario. He will serve as direct factory liasion man in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland and Labrador. With the company since 1951, Ster was promoted from regional service engineer in the Eastern regional office at New York City.

**Arthur C. Edwards,** newly-appointed field engineer of **Chiksan Company,** will maintain close contact with customer and prospect personnel and with visiting personnel of foreign operations. In addition he will handle special assignments and projects. Edwards joined Chiksan in 1946 as design and tool engineer, and was appointed senior salesman handling field engineering problems in 1948.

**Angus Lightfoot-Walker,** vice president in charge of Rheem International, is a new director of **Rheem Manufacturing Company,** industrial firm with 14 facilities in the U. S. and 17 abroad. Walker joined Rheem Australia as sales manager in 1937. In 1951 he became vice president of Rheem International which handles Rheem's overseas investments and sales.


## Tips on Mud Valves for Toolpushers...



MUDWONDER valves on the mud manifold and in jet service

# Rockwell-Built MUDWONDER Valves Record Two-Years on Mudlines With "Zero" Maintenance

By J. W. "Bill" Hall, Drilling Superintendent
Durham Drilling Co., Midland, Tex.

FOR THE past two years I have been using Rockwell-Built MUDWONDER mudline valves as replacements on our rigs. They are in service on jet guns, mud manifolds, fill-up lines and standpipes, and have given trouble-free operation under all conditions. In the two years since we started using MUDWONDER valves, our maintenance costs on them have been "zero" because no parts have been replaced.

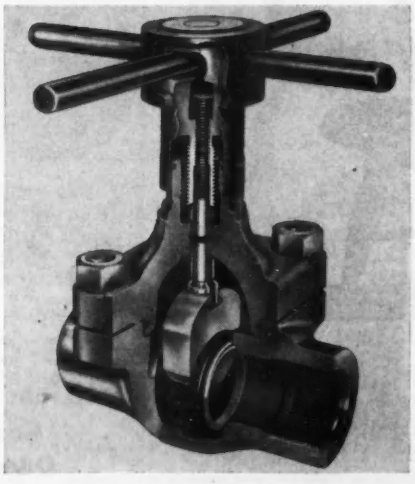
When deciding on equipment for the new rig, we checked our MUDWONDER records which left no doubt about the valve to use performance-wise and economy-wise. Needless to say, as replacements become necessary on our other rigs we plan to continue installing Rockwell-Built MUDWONDER Valves.

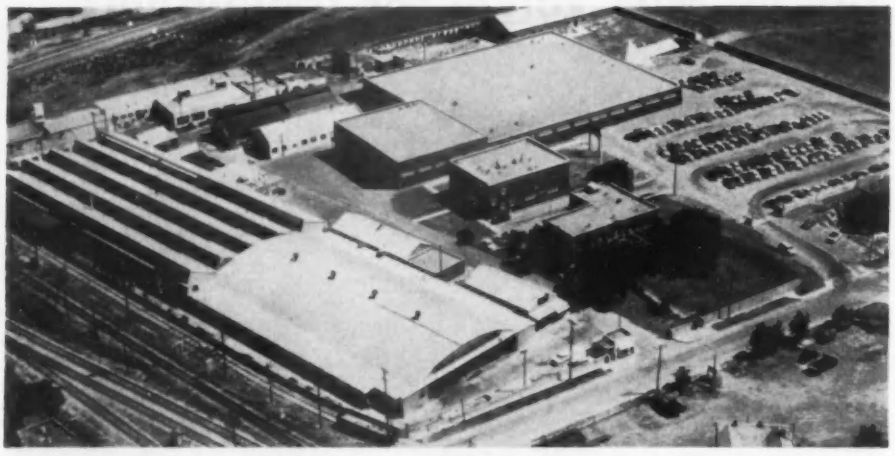
Freedom from maintenance is most important but easy operation is another MUDWONDER feature that makes a hit on our rigs. Regardless of pressure or position of the MUDWONDER it opens or closes quick and easy. We never need a cheater.

I can recommend MUDWONDER to anyone having mud valve trouble. MUDWONDER valves are built in 2", 3", and 4" sizes with screwed or flanged ends for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test).

Your favorite oil field supply store can give you complete information, or write Edward Valves, Inc., East Chicago, Indiana. Shipments can be made from East Chicago or the Edward Houston warehouse through the supply store you select. (Adv.)

MUDWONDER cut-away view shows the double thread construction, separated stainless stem and hard chromed gate with "T" slot connection and the one-piece seat insert with the buna-N molded integrally over the steel wear rings.





## *Guiberson Expands Manufacturing Plants*

**Shown drawn-in in its proposed location among present Guiberson plants and office buildings is the new oil field equipment manufacturing building (white arrow) to be completed in late-1956 in Dallas. Covered shipping dock facilities to accommodate 12 automotive trucks will be a part of the new single-story brick building. A second part of the expansion program is an announced expansion of the Guiberson rubber plant. Completion of the two-part program will give an increase in manufacturing plant working area of more than 80 percent and in rubber plant working area of over 65 percent.**

### Lufkin Foundry Subsidiary Opens Edmonton Headquarters

The Lufkin Machine Co., Ltd., has moved into new headquarters in Edmonton, Alberta, Canada. The building has two overhead cranes, 4000 square feet of floor space and two acres of land with 180 feet of railroad siding.

The company, Canadian corporation and subsidiary of the Lufkin Foundry and Machine Company, renders a complete sales, engineering and maintenance service, merchandising two products, Lufkin pumping units and gears and Gaso pumps.

Jack E. Gissler, resident manager of Canadian operations with headquarters at Edmonton, is assisted there by Len Ruzicki and Jack Leary. Bob Dunlop headquarters in Regina, Saskatchewan, and is manager of sales and service in Saskatchewan and Manitoba.

### Conoflow Corporation Merges with Walworth

As a result of an exchange-of-stock agreement between Conoflow Corporation and the Walworth Company, Conoflow will become an operating subsidiary of Walworth effective January 3, 1956. As an independent subsidiary, Conoflow will operate under same policies, with no change in management or personnel. It also will retain its existing plant in Philadelphia.

Founded in 1943, Conoflow manufactures final control elements, including automatic control valves, pneumatic power operators and air regulation equipment. The merger will provide the company with a broader financial base to expand research and development activities, increase inventory and acquire additional manufacturing facilities. Walworth Company, producer of industrial valves and fittings, will benefit by realizing a more extensive diversification into the field of automation used in the process industries, the power industry and atomic energy development.

### Texas Instruments Establishes Eastern Marketing Office

An Eastern region marketing office has been opened in New York City by Texas Instruments Incorporated the third step for the firm in the establishment of marketing headquarters throughout the U. S. Personnel in the new office includes Jay R. Reese, Semiconductor Products division district manager, C. M. Bedell and Alan S. Kumble, Components Division sales engineers, and W. V. McGalliard, Apparatus division service engineering representative.

Your production man can throw away his bicycle and do a better job from a rocking chair. He no longer has to run all over the field twisting valves.

An entire lease is controlled accurately and precisely in a matter of minutes, right from the old rocking chair, through a battery of Willis Rotary Adjustable Chokes.

**6 WAYS BETTER FLOW CONTROL**

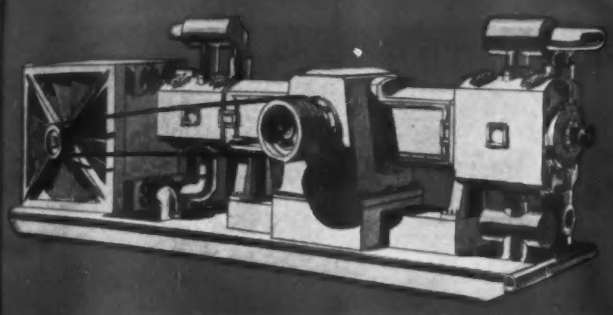
WILLIS Rotary Adjustable Choke provides 6 different sized choke inserts which are individually positioned in the line of flow by a fractional turn of the orifice-carrying disc . . . while under constant flow and high pressure. The 6 graduated orifices are changed to a new range of sizes in minutes . . . without shutting-in the well.

**WILLIS OIL TOOL COMPANY**

**3440 Pine Ave., Long Beach 7, California**

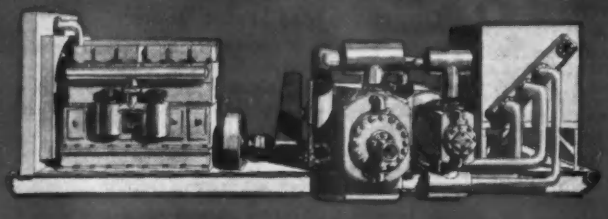
**Houston: 2012 Taft Street**

**Odessa: 100 N. Texas Street**



# Cooper-Bessemer Compressors

# FOR AIR DRILLING



TOP: Type EM-2, rig-powered, skid-mounted, 2-cylinder air drilling compressor. Rated 200 to 300 hp at 450 rpm.

BOTTOM: Type FMP-2, independently powered, skid-mounted, 2-cylinder air drilling compressor. Rated 150 to 300 hp at 300 rpm.

*Another Example of Efficient Power at Lower Cost*

Today's widespread experience and experimentation in air drilling leaves no doubt about the need for true *heavy-duty* air compressor equipment. Illustrated above are two of various units developed by Cooper-Bessemer to meet this need.

Although compactly packaged and meeting all requirements for portability, these complete units offer the long life, continuous operation and extreme durability for which the larger Cooper-Bessemer compressors have long been known. And, since any one of these units will outlast a number of the high speed compressors commonly used, it is certain to live through a well completion, insure an increased rate of penetration and contribute to big reductions in drilling cost.

In addition, Cooper-Bessemer offers you a choice of packaged units to meet your particular needs perfectly. For example, as shown, there are units designed to be rig powered and others equipped with their own engines. Moreover, since these packaged units are equipped with the same standard heavy-duty cylinders used on larger Cooper-Bessemer compressors, it is possible to cover extraordinary pressure and volume ranges and employ exceptional unloading facilities.

The nearest Cooper-Bessemer office will gladly give you complete data on the ideal setup for your requirements. Get in touch with them.

MOUNT VERNON, OHIO

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New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

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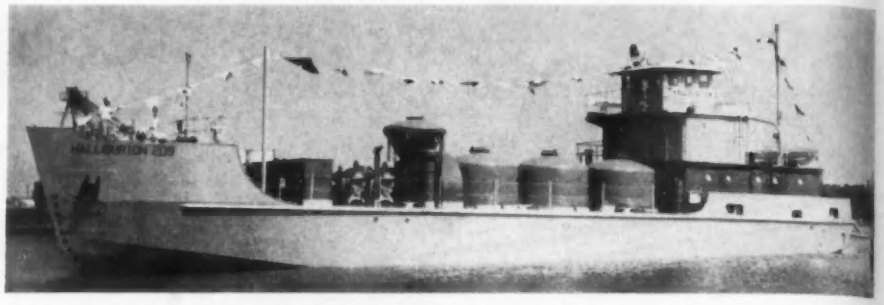

## *Two Vessels Join Halliburton Fleet*

**Two major vessels have been added to Halliburton Oil Well Cementing Company's marine fleet for inshore and offshore work in Louisiana and Texas waters. The "Halliburton 209" and "Halliburton 210" are similar in construction and design, each being 124 feet long and carrying three T-10 pumps, 5500 sacks of cement and additives and other service equipment. They can cross an ocean safely or navigate the shallow marsh and bayou areas of the Gulf Coast. Above, the "209" makes a trial run following its New Orleans launching.**

### Santa Fe Railway Completes 49.3-Mile Line Into Dallas

Completed late in 1955, Santa Fe's new main line into Dallas is 49.3 miles long, the longest section of main line track any railroad has laid over new territory in the U. S. for over a quarter of a century. It provides a new entrance into Dallas from the North.

This extension of Santa Fe's transportation facilities in north Texas reduces freight line distances from northern and eastern points by 65.2 miles and substantially reduces terminal delay, eliminating hours from freight schedules to and from the North and East. The line runs from Dalton Junction in Denton County, Texas, to the Zacha Junction in Dallas County.

### Alten Foundry & Machine Works Completes Annual Sales Meeting

Sales personnel and field engineers of the Petroleum Equipment division of Alten Foundry and Machine Works recently completed the regular semi-annual sales meet at the company's executive offices in Lancaster, Ohio. New pumping unit models were shown for the first time and new features were introduced.

### Kaiser Steel Corporation To Ship Pig Iron to Japan

Kaiser Steel Corporation has signed a contract for the shipment of 110,000 gross tons of pig iron to Japan. Shipments, made from the Fontana plant through the Port of Long Beach, began in November, 1955, and are expected to continue for more than a year.

### General Electric Division Organizes Mid States District

Formation of a new sales district has been announced by General Electric's Construction Materials division. The new district, to be called Mid States, will cover the trading areas of Cincinnati, Dayton and Columbus, Ohio; Indianapolis and the southern half of Indiana; Charleston and Parkersburg, W. Va.; and all of Kentucky.

Linvill L. Young, named manager of the new district, will direct operations of the sales representatives and marketing activities of the division's product lines for the area. With General Electric since 1934, Young was Wire and Cable specialist in Cincinnati prior to this latest appointment.


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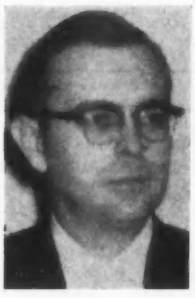

Philip Stoore

## Bishop and Stoore to Manage Two New PGAC Branches

Perforating Guns Atlas Corporation has opened new branch offices in Fort Worth and Tulsa. Bryan O. Bishop, technical representative, is in charge of the Fort Worth office; Philip Stoore, Jr., technical representative, has been placed in charge of the Tulsa office.

Bishop was with North Basin Pools Engineering Committee and the Standard Oil Company of Texas before joining PGAC in 1952 as neutron evaluation engineer. He has been in the West Texas division until his recent promotion to the Fort Worth Office. Stoore joined PGAC early in 1951 as a logging operator at Alice, Texas, and was sent the next year to the company's Canadian branches to train operators in newly-developed logging techniques. He then served three years as district radioactivity engineer in the five Oklahoma branches until his recent promotion.

Other promotions and transfers in the PGAC staff include Paul Felder, sales representative at the Lake Charles office, transferred to the Shreveport office; and Charles Melvin, sales representative at Liberal, Kansas, transferred to Great Bend, Kansas, to serve in the same capacity.

## Pacific Coast Borax Converts Mining System; Builds New Plant

Pacific Coast Borax Company, Division of Borax Consolidated, Limited, announces plans to convert its present system of mining at Boron, Calif., to open-pit and to construct new concentrating and refining plants at the minesite. Recent developments in technique and equipment now make possible the recovery of virtually the entire orebody at Boron by open-pit methods.

Since character of the ore recovered will be different from that obtained by more selective methods, a substantial change in process had to be developed to yield optimum results. The new concentrating and refining plants to be erected at Boron will handle all grades and varieties of ore and will produce borate concentrates required for the export trade and the principal forms of refined Borax for domestic and foreign markets.

The new facilities, which will cost around $18 million, are expected to be in operation the latter half of 1957.

## Braden Winch Completes Office Building In Oklahoma

Braden Winch Company has completed an office building at its plant at Broken Arrow, Okla., to house sales, advertising, accounting, material control, purchasing, engineering and executive offices. The building is of stone and brick, in ranch-type design. Braden Winch moved its headquarters from Tulsa to Broken Arrow in 1948 as an expansion project.

## Two Divisions to Handle Kewanee-Ross Operations

American Radiator & Standard Sanitary Corporation has dissolved its wholly-owned subsidiary, Kewanee-Ross Corporation, and has formed two American-Standard operating divisions to continue Kewanee-Ross operation.

The divisions will be the Kewanee Boiler division, Kewanee, Ill., which will manufacture Kewanee boilers, and the Ross Heat Exchanger division, Buffalo, N. Y., which will produce Ross heat exchangers, surface condensers and allied products.

W. B. Russell, president of Kewanee-Ross Corporation, has been named president of the Kewanee Boiler division. E. M. Palmer, vice president of Kewanee-Ross, will become executive vice president of the division.

John C. Linsenmeyer has been named president of the Ross Heat Exchanger division, with Richard S. Reade as executive vice president. Linsenmeyer is president of American Blower Corporation, also a division of American-Standard. He will continue to serve in that position as well as president of the Ross Heat Exchanger division. Reade has been director of purchases of the Plumbing and Heating division of American-Standard.

# WORLD OIL'S Trading Post CLASSIFIED ADVERTISING

**RATES: Regular Classified** (undisplayed) set in this size type: 12 cents per word. Minimum charge, $3. Blind box address in our care counts six words. Replies forwarded without charge. **Situation wanted ads,** 6 cents per word. **Display ads,** set in suitably larger type with ruled border, $12 per column inch; situation wanted display ads, $6 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance. COPY DEADLINE:** 17th of month preceding date of issue. Send copy and checks to: **Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.**

### FOR SALE

■ NATIONAL T-12 rig on 32′ Tandem Trailer, 145 HP Motor, complete except drill pipe. First class condition, approx. 8 months old. Box 79-W, WORLD OIL, Houston, Texas.

■ ELI DRILL M6D-164-D on 1948 Ford. New motor, good rubber. 22′ Mast, 13′ Kelley. 4½ x 5 GD Pump, 150′ Rod, slush pit and bit subs. SeisDrill Inc., 515 Thompson Bldg., Tulsa, Oklahoma.

■ FOR SALE: 10″ and 16″ Standard pipe threading machines powered with 10 H.P. DIEHL and Western Electric 3 phase electric motors. Especially suitable for pipe work in irrigation areas and priced reasonable. Service Specialty Co., Box 1316, Artesia, New Mexico.

**FOR SALE: Premises of Dunlap & Graham at 2450 Cerritos Avenue, Long Beach, California. Ideal for Drilling Contractor, Oil Well Supply Yard, Etc. Price $35,000.00, or might consider long term lease.**

FOR SALE: 7″ O.D. x 24′ Gammaloy Drill Collar. Brand New. Never Been Run. Cost $4930.00. Take $4500.00. Dunlap & Graham, 2450 Cerritos Ave., Long Beach, California. Phone 43961.

### MISCELLANEOUS

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### FOR LEASE

■ FOR LEASE—320 acres of land for immediate drilling, at Kramer, California (70 miles north of San Bernardino). Favorable report given by major oil company, which does not wild cat. Write to, or see in person—Paul Ribnikkar—Kramer (via Hinkley) California.

### SITUATIONS WANTED

■ LANDMAN, degree in geology, desires position with an independent working out of Houston, Box 76-W, WORLD OIL, Houston, Texas.

### BUSINESS SERVICE

**Well organized, well established oilwell drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties, from acquisition to production. No properties too small, and none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire, or call collect for further information.**

**MAKIN DRILLING COMPANY**
**P. O. Box 1628 — 146 Allen Building**
**Hobbs, New Mexico — Midland, Texas**
**Phone 3-3141 — Phone 2-2962**

■ Delaware Corporations formed and serviced. **Inquire without obligation. American Guaranty & Trust Company, 910 West Street, Wilmington, Delaware.**

NEWLY ORGANIZED DALLAS INDEPENDENT OIL COMPANY DESIRES TO PURCHASE PRODUCTION AND WILL INSPECT MERITORIOUS PROPERTIES SUBMITTED IMMEDIATELY. BOX 74-W, WORLD OIL, HOUSTON, TEXAS.

### HELP WANTED

■ SEISMOGRAPH COMPUTER. Must have experience and free to travel. Box 78-W, WORLD OIL, Houston, Texas.

■ Professor of Petroleum Engineering to be responsible for undergraduate curriculum and graduate courses. M.S. or Ph.D. Interest in research desired and full cooperation of University assured. Rank and salary dependent upon education and experience. Box 81-W, WORLD OIL, Houston, Texas.

# New Books, Maps and Movies

**SAFETY ON A ROUND TRIP,** AAODC Headquarters, 321 Insuromedic Life Building, 505 North Ervay Street, Dallas, Texas.

This new color film, released by the American Association of Oilwell Drilling Contractors, demonstrates various safety practices recommended during drilling rig operations while on a round trip. Included are the necessary steps in bringing up drill pipe out of the hole and proper treatment and handling of slips, tongs and other rig equipment prior to lowering the drill pipe back down the hole.

Shown in these various operations are the proper way to get the kelly out of the hole and into the rathole; how to take hold and latch elevators to the drill stem; how to use tongs properly for breaking out the pipe; proper safety procedure for the derrickman; proper use of pipe hooks by a floorman; proper way to lubricate slips, check tong snub lines, and how to do other steps connected with good housekeeping while the drill pipe is out of the hole.

•

**SASKATCHEWAN PERMIT MAP,** Department of Mineral Resources, Government Administration Building, Regina, Saskatchewan, Canada. $5.

Separate color designs identify the lands held by the 15 principal permit holders in the province on the revised Petroleum and Natural Gas Permit Map of Saskatchewan now available. Dated October 1, the map is 39 inches by 34 inches, with a scale of 12 miles to the inch.

Separate marking systems identify crown acreage under lease, crown acreage under lease and drilling reservation and crown acreage under drilling reservation. Below the map area is a listing of all permit numbers, size and dates, as well as holders of permits.

•

**NATURAL-GAS STATISTICS,** by Richard C. Henshaw, Jr., Bureau of Business Research, College of Business Administration, The University of Texas, Austin. $2.

Published primarily as a supplement to *Economics of Natural Gas in Texas,* co-authored with John R. Stockton and Richard W. Graves in 1952, this book provides the most useful and up-to-date information available in the field of natural gas economics.

In most instances, tables, charts and figures which were presented originally in the above-mentioned book have been brought up to date, from 1950 to 1953. Some new tabulations have been substituted, however, because of unavailability of more recent data. The numerical sequence of the tables, charts and figures of the original book were followed to facilitate the task of referring from this supplement back to the first book.

•

**MAP OF SASKATCHEWAN,** A. R. Dahl, Administrator of Petroleum Lands, Petroleum and Natural Gas Branch, Administration building, Regina, Saskatchewan, Canada.

The second in a series of maps showing Crown petroleum and natural gas rights available in Saskatchewan is now available. The map sheets are 22 inches by 17 inches and show Crown lands available as of October 1 in white blocks, and red blocks for Crown lands under disposition.

Lands north of a line from approximately Yorkton to Cathkin and jutting sharply northwest to a point slightly northwest of Lloydminister are available by application to a maximum of 100,000 acres.

•

**YEARBOOK OF SASKATCHEWAN'S PETROLEUM AND NATURAL GAS INDUSTRY,** Department of Mineral Resources, Legislative Building, Regina, Saskatchewan, Canada. $3.

A complete history of Saskatchewan's petroleum and natural gas industry from the turn of the century to the end of 1954, the yearbook includes data on exploration, development, production and land activity over the 54-year period. Tables, graphs, a 15 by 15-inch map showing petroleum and natural gas production and dispositions areas, and a stratigraphic correlation chart of Saskatchewan also are included. The map, in black and white, shows oil fields, gas fields, combination fields, oil and gas pipe lines and oil wells.

Sections contained in the report include exploration and development between 1900 and 1954, reserves and production, crude oil and natural gas disposition and well head prices—value of crude oil and natural gas, refining operations, pipe line construction and land statistics.

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## *McCullough Log Saves $40.00 Per Foot Coring Cost in Offset Well*

This was well #2 of a drilling program, an offset to the first well in the area which was cored completely. Depth of operation was below 5,000 feet. 5½" O.D. 15 lb. casing had been cemented through the pay zone.

A McCullough Radiation Well Log was run obtaining Gamma Ray and Neutron curves and a simultaneous collar log. McCullough's Logging Engineer computed porosities from the Neutron Log, applied shale and thin bed corrections and located the 18 foot oil zone to be perforated between 5,050 and 5,068 feet. The porosity graphs and slope of the curves were determined from cores from the key well.

108 improved ½" Ogival Bullets were fired in the pay zone, six per foot, by 4¼" O.D. McCullough M-3 Bullet Perforators. Result: A good well, and it took only four hours to complete the logging and perforating.

Other offset wells in the field will be completed in the same way, saving $40.00 per foot in coring costs through the zones that would ordinarily be cored.

This is another fine example of the accuracy and reliability of the McCullough Radiation Well Logger, and its outstanding value as a correlative instrument.

# McCullough Log Helps Turn Water Well Into Oil Well

## *McCullough Radiation Well Logger Accurately Locates 3½ Foot Oil Zone Missed by Previous Log.*

While this was a wildcat well, the producing horizon had the same general characteristics as other wells in the basin; the usual gas cap, a very thin oil zone and a transitional zone. It was a typical tough completion problem calling for exact, detailed logging information and "pin point" accuracy in perforating.

First logged and perforated by another service company, the well flowed water. Depth of operation was below 5,500 feet and 5½" O.D. 14.5 lb. casing had been set through the producing horizon.

After squeezing to shut off the water flow, the operator called McCullough. A McCullough Radiation Well Log was run obtaining Gamma Ray and Neutron curves and recording a simultaneous collar log.

The McCullough Radiation Well Logger is the most accurate, reliable and efficient logging instrument available. It has greater stability, provides more detail and assures more accurate quantitative interpretation. You can be sure of exactly locating, defining and interpreting potentially productive formations—thick or thin.

It was found that the previous log had been ten feet deep on casing collars, formation tops and total depth measurements. In addition the log had been interpreted so that the oil zone was shown to be 30 feet into the transitional zone.

The McCullough Log accurately identified and exactly located the gas cap, a 3½ foot oil zone, then the transitional zone. The gas cap contact was perforated for a squeeze shut-off and the 3½ foot oil zone was perforated by ten McCullough Super Formation Glass Jets. The well was then fractured and is now a good, commercial, water free oil well. Total logging and perforating time was only three hours.

There are many actual jobs such as this where the accurate, reliable, easily interpreted information provided by the McCullough Radiation Well Logger has turned a total loss into a profitable operation.

For best results, always call for the McCullough Radiation Well Logger. The most dependable logging equipment available.

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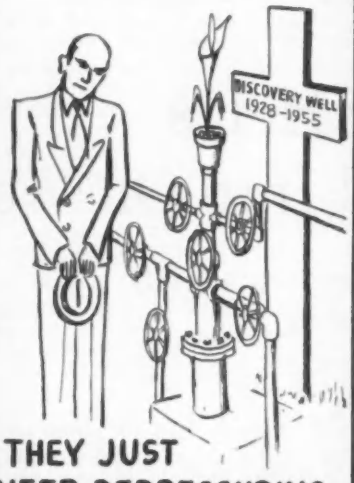


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## Good Bidding

One night at a friendly little game of contract bridge between two couples, something went wrong with the bidding. "I can't imagine," said one wife to her husband, "what you bid no trump on when I had three aces and four kings."

"If you must know," admitted the husband, "I bid it on one queen, two jacks and three highballs!"

## Nothing More, Dear

Bride-to-be: "After we're married, darling, I'm going to be a real good wife. I'll cook, sew, darn your socks, keep the house nice and clean and do my best to save money. What more could a man ask?"

Prospective groom: "Nothing I guess, unless he was evil minded!"

## Drilling for Gold

Dentist: "I thought you said this tooth hadn't been filled before? I find traces of gold on my drill."

Patient (feebly): "Perhaps you've struck my collar button."

## A Bit Familiar

The doctor had been called to look over Grandma, who had been complaining of aches and pains. He gave her a thorough going over.

After he left, Grandma seemed to perk up a bit. "What did you say was the name of that new minister?" she asked.

"That wasn't the minister—that was the doctor," she was told.

"Hmmm, I thought he was a bit familiar for a minister," Grandma replied.

## Real Beauty

A woman who had heard of the reputation of the great wit decided to risk his best brand of humor.

"Sir," she questioned, "what do you consider the most beautiful thing in the world?"

"A beautiful woman, of course," answered the humorist.

But the lady, having suffered considerably through long periods of sleeplessness said, "I disagree. I think sleep is the most beautiful thing in the world."

"Ah, yes," was the prompt reply, "next to a beautiful woman."

## Frugality

A Scotsman was leaving on a business trip and called back as he was leaving, "Goodbye all, and dinna forget to take little Donald's glasses off when he isn't looking at anything."

## Worse Than Fibs

First Mother: "Are you bothered by your children telling fibs?"

Second Mother: "Not so much as by their telling the truth at the most embarrassing moments."

## Partnership No Less

Two old maids ran a drug store. One day a husky chap came in and asked, "Have you a man working here? I'd rather talk to him."

"No, we own the place and we are the pharmacists. You can confide freely in us, just as any doctor. Don't be afraid," the women assured him.

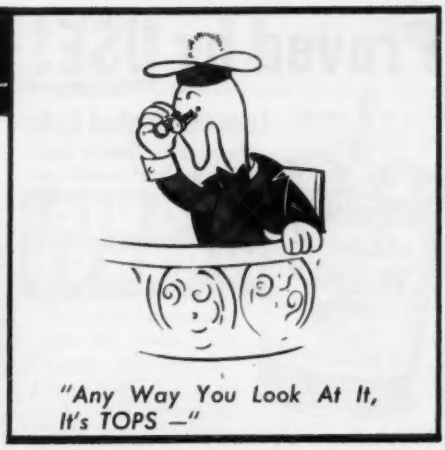
"Well, here's my trouble," the young man replied hesitatingly. "I'm very susceptible to women. They excite me so. I constantly get impulses to grab them, to hug them, to squeeze them. And those impulses are so strong—well, they are just overpowering. What can you give me for that?"

"Can you wait, sir?" asked the sisters. "We'd like to talk it over for a few minutes."

The old maids retired to the prescription room and returned smiling five minutes later.

"We can give you $100 a week and 50 percent of the business," one old maid said.

"Daddy, come and look what we air-drilled with my bicycle pump . . ."



*"Any Way You Look At It, It's TOPS —"*

**HOW LONG . . . do you wait for your Block to FALL after racking each stand of pipe?**

**SAVE: seconds per fall.**
**SAVE: minutes per trip.**
**SAVE: hours per well.**

*Illustrated left: McKissick Traveling Blocks designed and built for SPEED!*

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Streamlined, smooth flowing lines eliminate all projections to catch derrick girts.

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### Profane Day

A man owned a parrot that had a bad habit of swearing. He decided to break the parrot of this habit, so he gave it quite a lecture on the evils of profanity and at the conclusion of his remarks the man said: "It's a nice day, isn't it?"

"Damn fine day," the parrot replied.

The man jerked it out of its cage and whirled it around in the air, then dunked the parrot in a pail of water until it was nearly drowned. The parrot was still gasping and shaking when the man restored it to the cage and said in a severe tone, "Now then, nice day, isn't it?"

"Yes, sir," the parrot replied. "But where the hell were you when the typhoon struck?"

### Unknown Origin

Husband: "I suppose you are still angry with me because I came home last night with this black eye?"

Wife: "Maybe you don't know it, but when you came home last night you didn't have that black eye."

### No More Stories

Mother: "Sit down, Tommy, and tell your sister a story."

Tommy: "Can't sit down, Mother. I just told Daddy one."

### Minor Surgery

"You don't seem to think much of him," said one lawyer to his partner in discussing a colleague.

"If he had his conscience taken out, it would be a minor operation," replied the partner.

### This Crazy World

Why is it that a woman wouldn't spend more than a dime for a ten-mile haul when she is alone but she wants a taxi to take her five blocks if escorted by a man?

### Suspicion

There was a man who was so suspicious of his wife that when she presented him with twins he insisted that he only recognized one of them.


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Composite Catalog, Page 3433

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# What's New In Equipment

## Drilling • Production • Exploration

### Gasketing Material

A tight-sealing gasketing material known as Garlock 662 and developed primarily for use in the oil and chemical processing industries by Garlock Packing Company is a cork base paper impregnated with Chemigum Latex, a water, oil and gasoline-resistant latex made by the Chemical division of the Goodyear Tire and Rubber Company.

Chemigum Latex permits use of gasketing at temperatures as high as 300° F. Maximum for ordinary vegetable fiber gasketing is 212° F.

The latex binder is not susceptible to changes in moisture content, thus eliminating shrinkage, a critical problem in ordinary gasketing using a glue binder or with cork paper without latex impregnation.

Elimination of shrinkage allows users to cut their own gaskets from Garlock 662 sheets in advance of actual needs. As the latex impregnation gives resistance to humidity, high temperatures and aging, storage is no problem.

Primary use for the gasketing is in compressors, oil and water pumps and processing equipment found in the oil and chemical processing industries. It also is suitable for equipment used outdoors where exposure to varying weather conditions is a problem.

Garlock 662 sheets or cut gaskets are made in thicknesses from .01 to .25 of an inch. Cut gaskets are available in a variety of shapes and sizes with outside dimensions up to 48 inches.

(This item supplements The Garlock Packing Company data on Page 1861 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

### Heavy Duty Clutches

New type clutches have been developed and field tested by engineers of the Rockford Clutch division of Borg-Warner Corporation specifically for heavy duty clutch service. Extensive tests have proved that characteristics of clutch plates used in the new Rockford clutches are best adapted for heavy duty machines such as tractors, trucks, cranes, shovels, bulldozers, tanks, earth movers and graders.

The clutches provide up to 100 percent more torque capacity and permit use of smaller diameter, less expensive clutches. Another advantage is that less lever or pedal pressure is required for engaging and disengaging. Work life of the new type clutch has been increased as much as 400 percent, cutting down time for adjustments or replacements to one-fourth. Heat dissipation has been improved to the extent that excessively burned or warped clutch plates have been eliminated. Clutch torque does not fade as heat increases.

(This item supplements Borg-Warner Corporation, Rockford Clutch Division data on Page 4391 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

### Highway Tractor Line

The White Motor Company's "9000" highway tractor line is now in production, and both gasoline and diesel models are available. Providing maximum "L" dimension for total gross vehicle weight, heavy loadings on the front axle, and a 90-inch dimension from front of bumper to back of cab, the new short wheelbase tractor is best suited for additional payload advantages not previously possible in restrictive limits of Bridge-formula-law states.

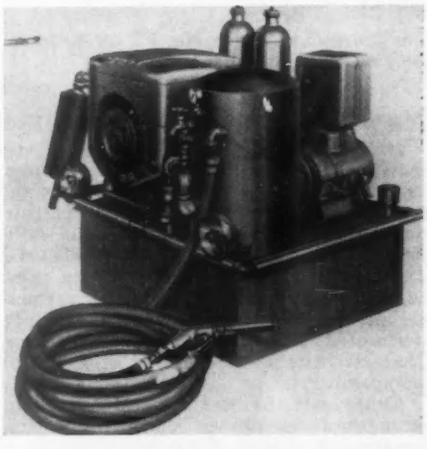
The tractor can accommodate a 35-foot high-cube trailer with a wide range of kingpin locations and remain within the 45-foot over-all length limit or a 40-foot trailer within the 50-foot over-all length limit. Front axle, springs, steering gear and frame are engineered to handle loading up to 11,500 pounds with complete safety. Mechanical ability and power also are designed to handle the additional payload.

The 90-inch dimension with the short wheelbase and fore-shortened front-end provides complete interchangeability, maneuverability and flexibility, as well as maximum payload cubage within the over-all length limits.

Available is a new series of four Mustang gasoline engines, ranging from 145 to 215 horsepower, engineered to give many combinations of multiple speed transmissions, two speed axles and other combinations. The tractor also is available with the Cummins diesel engine and the new PT diesel fuel injection system capable of high mileages with outstanding fuel economy and a minimum of adjustments or repairs.

(This item supplements White Motor Company data on Pages 5138-5149 and 4792 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.



### Fire Fighting Apparatus

A portable and multi-purpose apparatus built of heavy galvanized and stainless steel by National Alarms Corporation combines fire fighting effectiveness with versatility of electric power. Called Versa-Power, this compact fire fighting unit is powered by an engine-generator for reliability and endurance.

The apparatus uses a U/L approved wetting penetrant that is most effective on oil fires, and its 3500 watt AC 60 cycle affords ready power for stand-by emergency use. No conversion is necessary. Because of its steel construction, the unit is suitable for use on offshore operations.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

### Spark Resistant Tools

Ingersoll-Rand announces a new line of paving breaker, demolition and digging tools for application in plants handling hazardous liquids or flammable gases or dusts which could be ignited by a spark. The tools are forged from a beryllium copper alloy, a material long known for its spark resisting properties, and used for years in cast tools for safety purposes. Greater life than that of their cast counterparts is claimed for the new spark resistant tools.

(This item supplements Ingersoll-Rand Company data on Pages 2597-2604 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

***Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue.***

# DRILLING

## Portable Offshore Platform

R. G. LeTourneau, Inc., is manufacturing a portable $2 million ocean-going platform for Zapata Off-Shore Company which plans to outfit it for drilling oil wells up to three miles deep along the Gulf Coast. Being built near Vicksburg, Miss., the self-elevating platform is scheduled to be launched before the end of the year and floated 400 miles down the Mississippi River to the Gulf.

When in operation, the platform will be towed to the proposed drilling spot where it will lower three legs to the ocean floor. Then the 8 million-pound machine will ease its platform upward until the deck is well above water. When drilling is completed, the deck will be lowered to the water again and the three legs lifted so it can be floated to the next drilling site.

Legs of the machine are each 140 feet high, permitting the apparatus to be used in 100 feet of water and still have its deck 40 feet above the surface. Powering the stilts are 63 electric motors, each with a gear reduction of more than 1000 to 1. Power is supplied by LeTourneau-built generators driven by diesel engines located below deck. The deck, which measures well over half an acre, will be equipped with air-conditioned living quarters for 42 men, offices for key personnel and storage areas for pipe and tools.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

## Heavy-Duty Hooks

A new line of heavy-duty hooks featuring the new hydraulic snubber and an optional hook positioner has been announced by Byron Jackson Oil Tools. The snubber is a shock absorber which eliminates the bouncing action when "jumping" drill pipe stands while coming out of the hole. This cushioning action prevents damage to the tool joints and reduces rig maintenance. The hook positioner automatically rotates the elevator into the correct position for the derrick man to catch the next stand of pipe while going in the hole.

Five models, with capacity ratings of 100, 150, 250, 350 and 450 tons, are available in the new hook series. Spring travel in the 100-ton model is six inches; other models have an eight-inch spring travel. All are manufactured to API standards.

All hooks in the series contain the same basic construction features: The hook body is attached to a solid one-piece forged shank of alloy steel; low-stressed relief springs are heat-treated and are enclosed in a housing for protection against grit, mud or damage. With the eight or six inches of spring travel, need for exact-spotting of the traveling block is unnecessary. The floating action assures greater ease in handling heavy stands of pipe, and burring of pipe threads thus can be avoided.

(This item supplements Byron Jackson, Division of Borg-Warner Corporation, data on Pages 905-1068 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

## New Cement

Halliburton Oil Well Cementing Company's Pozmix 140, a cement tailored especially for wells with over 140° F. temperature, is a pozzolanic cement recently adapted to oil well cementing. Especially designed to protect deep, hot wells, the Pozmix 140 requires lower pumping pressure, provides a more impermeable set material, has a low water ratio and is easily perforated. Absence of premature gelling characteristics gives a slurry of excellent pumpability.

Other advantages include excellent strength under proper conditions of temperature, low heat of hydration yet comparable WOC and temperature survey time to other cementing materials and no retrogression in strength under high pressures and temperature.

(This item supplements Halliburton Oil Well Cementing Company data on Pages 2121-2220 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

## Circulating Whipstock

The circulating whipstock, announced by Shipco Control Drilling Service, has extra length below ring which allows more accuracy in directional settings. It also has more shear pin space. The Shipco circulating whipstock is circulated to bottom, eliminating extra runs, to clean hole of cuttings and cavings, assuring a clean hole for setting of whipstock.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

## Rotary Shoe

A recent development in the field of wash-over cutting equipment is the Klustrite rotary shoe, developed by Houston Oil Field Material Company, Inc.

The process of applying Klustrite to the metal basically is similar to the method of setting diamonds in a bit. Carbide slugs, such as are used in machine shop lathe cuttings tools, are first fractured into jagged fragments about ⅛-inch to ¼-inch in cross section. These fragments are then interspersed into a suitable matrix on the shoe, but are not spaced in any geometrical pattern. The small fragments are supported on all sides by the matrix or bonding material which has sufficient resiliency to allow movement of the carbide particles under impact, serving as a sort of shock absorber, and yet which is tough enough to withstand severe loading.

In the Klustrite method an infinite number of cutting edges are available. When one edge dulls, another takes over, causing efficiency of the shoe to remain constant throughout the operation.

(This item supplements Houston Oil Field Material Company, Inc., data on Pages 2337-2368 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

## Radioactive Cobalt

Radioactive cobalt, in its first application to production of oil field equipment, is now being used by Brewster Company to test heavy steel drilling equipment for internal defects.

Similar in application to industrial X-ray, cobalt is able to traject powerful gamma rays through eight inches of cast steel to expose radiographic film. The electromagnetic radiations darken photographic film; should the casting contain internal cracks, gas cavities or inclusions of sand or slag, a shadow graph will appear on the film. A solid casting produces a light area.

Flexible, portable and simple to operate, cobalt 60 has energy corresponding to that of a 2 million volt X-ray machine and an initial cost for less. Highly radioactive, the cobalt isotope at the Brewster foundry is housed in a 150-pound lead shielding container with a lead wall thickness of 3⅞ inches.

Since the gamma rays traject a full 360 degrees, Brewster facilities are set up to expose castings in volume. Particularly adaptable to pilot runs on all heavy casting work, cobalt radioisotopes also inspect the internal structure of pressure fittings, tubing heads and other critical parts of oil field christmas trees.

(This item supplements The Brewster Company, Inc., data on Pages 809-844 A-B-C-D of the Composite Catalog, 21st Edition.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

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*...as a driller said recently.*

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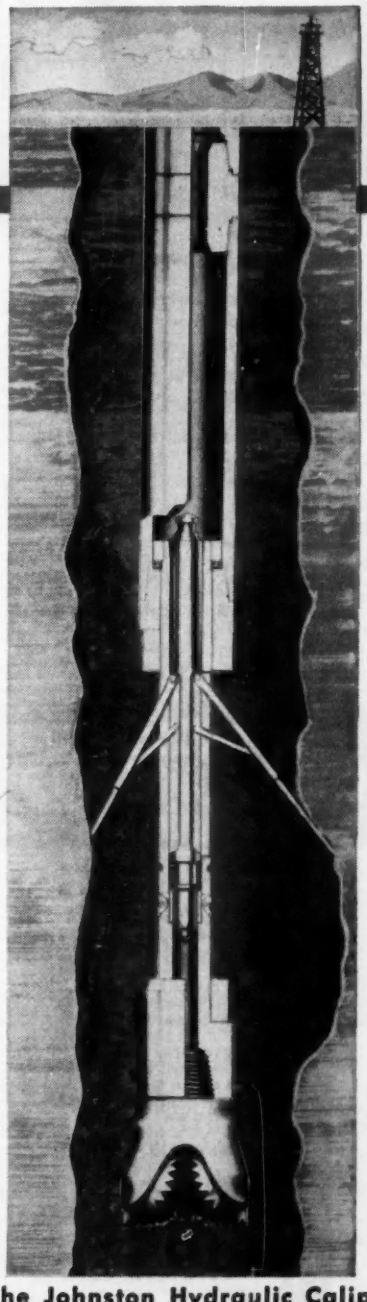

**The Johnston Hydraulic Caliper** provides accurate information on hole diameter from bottom to top. Information you can use with confidence.

**Whatever the hole condition,** you can be sure of getting a complete picture with the Johnston Hydraulic Caliper!

**Saves time!** No need to stop and rig up wire line. No delay or difficulty in crooked or directionally drilled holes.

**Saves money!** The *only* hole caliper that can often pay the cost of calipering in savings in rig time. The Johnston Hydraulic Hole Caliper is dropped into the drill pipe just before pipe is removed. Measures and records hole diameter as pipe is pulled from hole. Pipe may be rotated out in normal manner.

**Accurate!** Records continuous diameter of hole, bottom to top, either at detail speed or normal charting speed. Each measuring arm functions independently assuring the accurate measurement of irregular shaped hole.

**Measures from the bottom!** With the Johnston Hydraulic Hole Caliper, you can always be sure of starting to measure at the bottom every time.

**When you get so many more** advantages by using the Johnston Hydraulic Hole Caliper, why ever use less?

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*TAFT, CALIF.
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* Calif. Rep. Emsco Mfg. Co.

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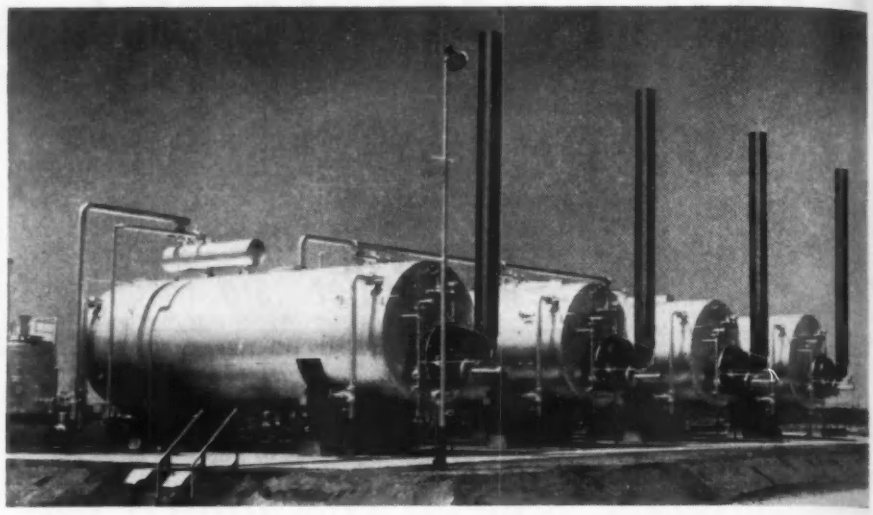
OIL TOOL CO.
1521 PRINCE ST., HOUSTON 8, TEX.

UN 1-1253
HO 5-7585 MI 9-0747 UN 4-0777
MO 5-6809 UN 9-1397 UN 4-4939

# PRODUCTION



## Horizontal Treater

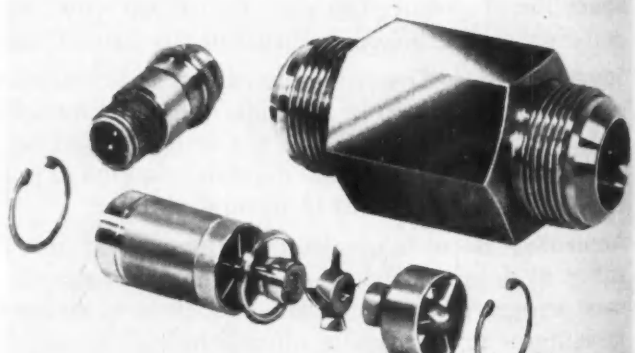
Black, Sivalls & Bryson, Inc., announces its all-new Model HGT horizontal treater which combines heating, settling and water removal in a single-chamber treating vessel for processing crude oil emulsions.

The single chamber vessel design provides increased water capacity, up to 8000 barrels per day. The oil-water interface is controlled by an interfacial float which more accurately controls the shallow interfaces encountered in horizontal treaters. An increased gas separation area insures dry gas at the gas outlet under normal conditions. Unusually large gas volumes can be handled by the addition of the optional gas dome. Relocated inlet flume, anti-foam baffles and an additional access manway are additional features of the new HGT.

(This item supplements Black, Sivalls & Bryson, Inc., data on Pages 649-660 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

## Turbine Meter



A turbine flow meter featuring wide range and high accuracy has been announced by Fischer & Porter Company. The meter gives precise flow rate measurement (plus or minus ½ of 1 percent of rate) up to 100,000 pounds per hour at specific gravity 1.0. Range is 20:1. Accuracy is not affected by piping configuration. Maximum pressure drop is 7 psi.

The meter consists of a fluid-driven rotor mounted in a short housing installed in the pipe line. The rotor turns at a speed directly proportional to the fluid velocity. Blades of the rotor are of a magnetic material, and as each blade passes a pickup coil containing a magnet, it induces an electrical pulse. The number of pulses produced is directly proportional to the speed of blade rotation and number of blades.

Pulse frequency of the output may be fed into a Bristol converter where it is converted to a DC voltage linearly proportional to the input. A Bristol indicating potentiometer translates the voltage level to true rate indication.

Specific gravity corrections are fed manually into the potentiometer so that indicated flow rate is in mass flow units. For digital readout of total number of pulses, an events per unit time counter may be connected directly or through a preamplifier to the meter pulse frequency output. This arrangement particularly is applicable for integrated flow and for batch operations.

The meter is furnished in standard sizes of ½, ¾, 1, 1½ and 2 inches with maximum capacities from 9 to 210 gallons per minute.

Exploded view of the new F & P turbine flow meter shows the rotor mechanism at the left and the electrical connection and the housing at the right.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

***Circle numbers on Readers' Service Cards on last page***

# New Equipment Catalogs and Literature

**For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Readers' Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.**

## Industrial V-8 Engines

The Le Roi Division of Westinghouse Air Brake Company has published a bulletin on the company's industrial H540 and H844 V-8 engines. Illustrated in photographs, charts, drawings and diagrams are design, performance and economy of the two engines which operate on gasoline, natural gas or LP gas.

The bulletin shows engine applications and lists specifications and available optional equipment.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

## Dual Completion Equipment

McEvoy Company announces completion of a comprehensive catalog which furnishes complete information on dual completion equipment, including dual trees, dual bore valves, combination valve and tee, and parallel string well completion accessories. Also included are data on 15,000-pound WOG valves and christmas trees. Cut-away drawings, performance curves, photographs, technical data and schematic illustrations are used to point up features of the equipment.

Also available is McEvoy's bulletin on "controlled friction" casing hangers, their capacities, prices and features.

To get a copy, circle **No. E15** on Readers' Service Card, last page this issue.

## Couplings and Fittings

Dresser Manufacturing Division of Dresser Industries, Inc., announces a catalog describing how Dresser couplings and compression fittings are used for piping in petroleum marketing. Including both photographs and drawings, the new catalog explains simplified methods of pipe connecting and maintenance. Tracing use of the Dresser products from tanks to pumps, and on truck and trailer piping, the catalog shows use of fittings for joining copper tubing and fittings for above and below ground piping.

The catalog also describes how standard coupling are used to connect centrifugal pumps to inlet manifold pipes and on discharge pipes from the pump.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

## Equipment Literature

Otis Pressure Control, Inc. has announced publication of three bulletins featuring equipment manufactured for the petroleum industry.

The first contains complete operating details, cost comparison data and case histories on a bottom-hole chemical injector, a tool for injecting liquid inhibitor in flowing or gas-lift oil wells or in high-pressure gas wells. The tool is especially designed for wells with a packed-off tubing-casing annulus which usually prevents conventional treatment with liquid inhibitor.

A second bulletin contains operating data on a new drill pipe nipple and removable plug. The equipment consists of a landing nipple built on drill pipe dimensions and a removable plug choke which seals off in the polished bore of the nipple. The assembly provides a quick, safe means of plugging drill pipe if the well begins to unload during drilling or work-over operations. The bulletin contains schematic drawings, cut-away illustrations of the equipment, and a table of available tool joint and landing nipple sizes.

The entire line of tubing and surface safety valves which Otil markets to oil and as operators is featured in the company's third bulletin. The folder describes the purposes, operating principles and design details of the valves, and illustrations typical installations.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

## Retainer Production Packer

Baker Oil Tools, Inc. has released a 72-page catalog on a single tool, the retainer production packer. Listing advantages of the modern packer for current and future production requirements, the manual also shows, in photographs and drawings, available accessories and setting tools.

Operating instructions and procedures and applications of the tool are described in detail. Specifications and ordering instructions also are included.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

## Slings and Fittings Brochure

Wire Rope Corporation of America, Inc. has issued a catalog featuring Wireco slings and fittings. With many different types recommended for specific applications, the catalog illustrates and describes 54 sling types with accompanying capacity tables for each. The most commonly used fittings also are illustrated with capacity tables.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

## Primary Cementing Tools

B and W Incorporated's latest booklet is a pictorial presentation of the construction, installation and usage of B and W scratchers and centralizers in conditioning a well.

The company's entire line of scratchers and centralizers are illustrated and described, with complete descriptions of where and how they should be installed. Also included are case histories, cost sheets and sample field service reports.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

## Power Pumps Movie

Installation and maintenance of power pumps is the topic of a new sound slide film prepared by Worthington Corporation. Part I is devoted to installation and covers information on foundation, suction conditions, piping support, cleaning, alignment, lubrication and testing. Part 2 on maintenance includes instructive information on initial and replacement packing, packing adjustment, common types of pump valves and tips on trouble shooting common pump problems.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

## Liquid Level Transmitter

The Foxboro Company's new bulletin describes closed tank liquid level measurement and control with the recently-announced cell liquid level transmitter. Among the features emphasized is installation simplicity. Only two small pressure taps are required in the tank, with direct connection by ½-inch pipe to the high and low pressure sides of the cell.

In addition to diagrams showing principle of operation and suggested installation layout, the bulletin lists complete specifications and dimensions. Also included are illustrations of other Foxboro liquid level components such as indicators, recorders and control valves.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

## Submersible Pump Film

A new film on the submersible method of pumping is announced by Byron Jackson Division of Borg-Warner Corporation. Titled "The Submersible Story," the film presents the history and development of the pump as well as its construction and operation.

The submersible's progress from early designs to present day applications and installations is shown. Extensive animation is used to illustrate the operation and make graphic the construction and working principles of key submersible parts, including the mechanical and mercury seals.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

## Waterflooding Pumps

Choosing the right waterflooding pump for secondary recovery operations is the subject of a recent bulletin published by Worthington Corporation. Separate rating charts present information on capacity, size and horsepower for the selection of nine types of vertical multiplex plunger pumps with pressures up to 5000 psi and displacements to 40,500 barrels per day. Information also is applicable for subsurface hydraulic pumping and salt water disposal operations.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

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